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Soviet Geography: Review and Translation

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Readers are invited to send in their comments and discussion of articles published in *Soviet Geography*. Readers are also encouraged to submit suggestions as to published Soviet geographic literature worthy of translation. Such suggestions should relate to articles of general substantive or methodological interest rather than materials of narrow, specialized appeal.

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TRANSLITERATION TABLE

Russian			English	Russian			English
А	а	*а*	a	Р	р	*р*	r
Б	б	*б*	b	С	с	*с*	s
В	в	*в*	v	Т	т	*т*	t
Г	г	*г*	g	У	у	*у*	u
Д	д	*д*	d	Ф	ф	*ф*	f
Е	е	*е*	e*	Х	х	*х*	kh
Ж	ж	*ж*	zh	Ц	ц	*ц*	ts
З	з	*з*	z	Ч	ч	*ч*	ch
И	и	*и*	i	Ш	ш	*ш*	sh
Й	й	*й*	y	Щ	щ	*щ*	shch
К	к	*к*	k	Ъ	ъ	*ъ*	"
Л	л	*л*	l	Ы	ы	*ы*	y
М	м	*м*	m	Ь	ь	*ь*	'
Н	н	*н*	n	Э	э	*э*	e
О	о	*о*	o	Ю	ю	*ю*	yu
П	п	*п*	p	Я	я	*я*	ya

(*) Instead of e, use ye at the beginning of names, after vowels and after the soft sign (').

The transliteration table is supplied for the general information of readers and to enable them to identify the geographic names on maps that will be reproduced from time to time in SOVIET GEOGRAPHY.

The transliteration system is the one proposed by the United States Board on Geographic Names. For more general use in textbooks and other popular needs, the following simplifications are recommended by the editor of SOVIET GEOGRAPHY:

1. Eliminate the use of (') and (").
2. Use i for iy, and y for yy.
3. Convert diphthongs ay, ey, oy, uy to ai, ei, oi, ui.

MOISTURE AND HEAT FACTORS AND THE GEOGRAPHY AND ECOLOGY OF THE PLANT COVER

By Ye. M. Lavrenko

(Abstract: The paper discusses, mainly from a programmatic point of view, the need for research into the relationships between climate and vegetation. Four lines of research are proposed: (1) the correlation between the distribution of vegetation and climate indices; (2) relationships between the distribution of vegetation and seasonal types of climate; (3) seasonal and annual changes in plant communities related to corresponding changes in the surface layer of the atmosphere and the soil and subsoil; (4) the exchange of matter and energy within an ecological system.)

Relationships between the vegetation and the climate of the USSR have been inadequately studied thus far. In their most general form they have been investigated by geographers and climatologists interested in the typology of climates and in climatic regionalization in connection with the division of the earth into landscape and geobotanical zones (L. S. Berg, M. I. Budyko, A. A. Grigor'yev, N. N. Ivanov, W. P. Köppen and others).

Recently a genetic, or dynamic, school has been developing in climatology in the USSR (B. P. Alisov, S. P. Khormov and others) concentrating its attention on the climate-forming processes in the atmosphere that produce given types of climates. V. B. Sochava investigated in an interesting study in 1948 the relationships between the vegetation of the USSR and the climate-forming processes and dynamic types of climate, having based himself on the work of the above-mentioned Soviet climatologists, chiefly Alisov.

There is also another Soviet school known as agricultural climatology or agroclimatology, which studies climate as a condition for the growth of cultivated plants and artificial cultivated phytocoenoses or plant communities (F. F. Davitaya, P. I. Koloskov, S. A. Sapozhnikova, G. T. Selyaninov and others). That school can be regarded as a branch of ecological or biological climatology.

Work in agricultural climatology is also of a certain interest for geobotanists. Unfortunately little work has been done in the Soviet Union in the geobotanical branch of ecological climatology, which has as its aim the study of climate in connection with the natural plant cover operating as an environmental factor of climate.

Many important geobotanists abroad are working on climatological aspects designed to solve botanical-geographical problems (in Poland, D. Szymkiewicz; in Germany, H. Walter; in France, L. Ambergé, H. Gaussen, A. Aubréville and others). In the USSR some aspects of

climatology important for botanical geography have been investigated by G. N. Vysotskiy. R. I. Abolin also gave attention to relationships between climate and the plant cover.

In this paper we will briefly discuss, mainly from a programmatic point of view, the research in the following fields: (1) correlative links between the geographical distribution of vegetation and individual climatic (moisture and heat) indicators or indices; (2) relationships between the geography of plant-cover types and seasonal types of climate regime; (3) seasonal and annual changes in plant communities related to changes in the heat and moisture conditions in the surface layer of the atmosphere and in the soil and subsoil; (4) the exchange of matter and energy within biogeocoenoses in connection with the radiational and moisture regimes of the habitat.

1. Correlative links between the geography of plant-cover types and climatic indices.

The literature contains many indices suitable for an integral characterization of climate, particularly the moisture and heat aspects of climate. I will not attempt to evaluate these indices. Suffice it to say that one of these indices, the aridity index, was proposed by G. N. Vysotskiy, a pioneer of Russian-Soviet soil science, geobotany and forestry, as the ratio of the mean annual sum of precipitation to mean annual evaporation.

The integral climatic indices that rest on the most solid basis from the viewpoint of physics are the indices proposed by M. I. Budyko (1956, 1958; Grigor'yev and Budyko, 1956, 1959) for the sum of warm-season temperatures of the active surface and the complex aridity index. The latter represents the ratio of the annual magnitude of the complex evaporability to the annual sum of precipitation. Evaporability calculated by the complex method is approximately proportional to the magnitude of the radiation balance and, on the average, corresponds to its value divided by the latent heat of vaporization.

A. A. Grigor'yev and M. I. Budyko uses those indices for studying the laws of zonal division of the earth's surface (1956) and for a climatic regionalization of the USSR in connection with the geographical distribution of the plant cover (1959; translated in Soviet Geography, May 1960, pp. 3-24).

These indices, which have been worked out by M. I. Budyko, should be further utilized for a climatic interpretation of the geobotanical regionalization of the USSR and entire continents, particularly for studying the climatic basis of geobotanical boundaries (of the rank of zone, subzone, province, subprovince, etc.).

2. Relationships between the geography of vegetation types and seasonal types of climate regime.

For nearly all the basic plant communities represented on the earth's surface, except for tropical rain forests, there exist within the course of the year seasonal changes of structure, i.e., a succession of phenological states, certain changes in the assimilating surface, and so forth, as well as changes in the physiological processes of the plants making up the community. These changes within plant communities depend directly on corresponding seasonal changes in the radiation regime and in moisture supply.

We are therefore in agreement with the statements of some plant ecologists that no integral climatic indices taken alone can fully explain the presence of certain vegetation types in a given area, and that an analysis of the causal relationships between vegetation and climate must take into account the seasonal characteristics of climate.

The seasonal characteristics of climate, of temperature and precipitation, are usually represented in climate diagrams showing the annual march of mean monthly temperatures and precipitation.

There are several ways of constructing such diagrams. It seems to me that the best is the one proposed by the noted French geobotanist H. Gaussen (Bagnouls and Gaussen, 1953; Gaussen, 1954, 1958) and worked out further in detail by the noted German ecological botanist H. Walter (Walter, 1955, 1958, 1958-59).

This method is based on the use of the temperature-precipitation relationship proposed by F. Bagnouls and H. Gaussen (1953). On the axis of abscissas of the diagram are plotted the months, in the case of the Northern Hemisphere from January to December; on the axis of ordinates are plotted the temperature in degrees centigrade on the left and the precipitation in millimeters on the right so that 10° C corresponds to 20 mm of precipitation. The mean monthly temperature curve is also said to give an idea of the potential evaporation from a free water surface or moist soil. The authors have shown that, in case of the Mediterranean region, drought occurs in the part of the year where the temperature curve lies above the precipitation curve. That fact was confirmed for other climate types, especially through the work of H. Walter. Climate diagrams constructed by this method thus clearly show a period of drought (Dürrezeit) and a period of adequate moisture supply. For semi-arid areas (wooded steppe and, in part, the steppe) of the temperate temperature belt, Walter furthermore proposed indication of a dry period (Trockenzeit) by constructing the temperature and precipitation curves in the relationship of 10° C to 30 mm. These climate diagrams also show graphically the winter months (with a monthly mean below freezing) and the months with a mean absolute minimum below freezing. Additional numerical indices are: the mean annual temperature in degrees centigrade, the mean annual precipitation, the mean annual minimum temperature of the coldest month, the absolute minimum and, if needed, the absolute maximum, and so forth.

Walter demonstrated that such climate diagrams could be applied to various types of climate, specifically to all of Turkey and Africa; by analyzing the climate diagrams he provided a climatic regionalization for these territories. East Germany will shortly publish a large world atlas of climate diagrams compiled by Walter and his associates.

In 1957 this method was used by O. A. Grebenshchikov to characterize the climate of various vegetation belts in the mountains of the eastern part of Western Europe. I myself used this method for a climatic interpretation of the situation of the wooded part of the Caucasus in the general scheme of geobotanical regionalization of the Palaearctic (Lavrenko, 1958), for a relative characterization of the climate of the steppe developed on loess-based gray soils in China's Kansu Province and the climate of short-grass semi-savannas in Soviet Central Asia (Lavrenko, 1959), for comparing the climate of the savannas in southern Yünnan Province of China with the climate of the African savannas, and so forth.

The method can be used to compile not only generalized climate diagrams covering a number of years, but also, so to say, concrete climate diagrams for individual years showing the march of mean temperature and precipitation indices by months or even by ten- or five-day periods. Such diagrams are irreplaceable when it comes to an interpretation of seasonal changes in plant communities, particularly changes in phenological spectrums observed in the vicinity of a corresponding meteorological station.

3. Seasonal and annual changes in plant communities related to changes in the heat and moisture conditions of the surface layer of the atmosphere and of the soil and subsoil.

Research of this type has been done and is being done in various natural zones at some of the field stations engaged in vegetation research, but not at all of them by far. In most cases such research suffers from substantial defects: (1) short duration; a few years of observation, often limited to several growing seasons; (2) lack of a uniform methodology and research program; (3) lack of provision for publication of the results of the research; (4) lack of combined summaries of the results of observations at a series of field stations, not to speak of the USSR as a whole.

Research on the temperature and moisture conditions of the surface layer of the atmosphere, the soil and subsoil in various types of plant communities should actually be organized in all nature preserves, which have happily been increasing in number in recent years. Such research should follow a uniform methodology and program, which should of course be adapted to the specific natural conditions, including vegetation, of each preserve. This research should continue for a dozen or more years if it is to investigate the effect of general terrestrial climatic change on plant communities (more precisely, on biogeocoenoses) of various types. The meteorological part of such research should be organized by the Hydrometeorological Service.

We will briefly discuss some methodological problems related to such research. In carrying out this research it should not be forgotten that the "active or underlying surface" of modern climatologists is actually a very complex structure that is always more or less stratified. Not only the plant community itself is stratified, but so is its environment, both in its atmospheric and in its edaphic parts; in other words the biogeocoenosis as a whole is stratified. The stratification of the plant community is reflected in the structure of its growth forms, which in turn is reflected in its most general form in the tiers of the plant community. The structure of the plant environment, both above and below ground, is intimately linked with the growth-form structure of the community. A good indicator of environmental stratification in the soil is its genetic horizons, which are usually also related to the surface part of a given growth form.

Phytoclimatic observations, including temperature, moisture, light, and so forth, must therefore be set up for each of the well defined growth forms both above and below ground; and if the growth form is very tall, for example, the tree tier in a forest, the observations should be appropriately extended along the vertical. Thus, in the case of a forest community, the following observations should be carried out during the growing season: at the surface of the crowns and in the crowns of all sub-tiers of the tree tier; at the surface of the crowns and in the crowns of the underbrush; at the surface of the herb (or shrub) cover and in its densest part; at the surface of the soil-covering plants (mosses, lichens), within and beneath that plant cover, and within the soil at various horizons depending on the distribution of the root systems of the various growth forms.

It is quite obvious that such research must be conducted all year round, with greater detail during the growing season and in simpler form during the autumn and winter.

4. Exchange of matter and energy in biogeocoenoses in connection with the radiational and moisture regimes of the habitat.

Both the Soviet literature (V. N. Sukachev, 1957) and the foreign literature have recently posed the problem of studying the exchange of matter and energy within the system biocoenosis-plant environment, in other words, in the biogeocoenosis (to use Sukachev's term) or in the ecosystem (as understood by Tansley and other foreign authors).

This research requires the study not only of seasonal changes in the structure of the phytocoenosis (phenology, changes in the assimilating surface, and so forth), seasonal changes in the plant environment, especially the light, temperature and moisture conditions of the atmosphere and the soil, the regime of nutrient matter in the soil, and so forth, but also of the basic physiological processes (photosynthesis, respiration, mineral metabolism, transpiration, and the plants' water regime in general) in the dominant species of all the principal growth forms of the plant community under study, especially its edifiers.

Such complex research programs can, of course, be organized only at a limited number of field stations. The research should continue over a period of years to make it possible to determine both the "normal" meteorological year and years that are abnormal in terms of temperature and precipitation.

It should be pointed out that research of this type requires a great deal of methodological preparation and a high degree of integration (interpenetration of parts of the research).

All this research represents a single series of studies ranging from the most general survey of climate-vegetation relationships using integral climate indices to the physiological, biochemical and energy-oriented interpretation of the use of climatic resources by vegetation, which essentially represents a thorough investigation into the nature of the physical-geography process in the phytogeosphere, i.e., the most active part of the biosphere.

THE FUEL BALANCE OF KUYBYSHEV OBLAST
(for enterprises under the regional economic council)

By Yu. N. Savenko

(From Vestnik Moskovskogo Universiteta, seriya geografiya, 1960, No.6, pp. 49-54)

(Abstract: This paper supplements a previous article published in Soviet Geography, March 1961, pp. 73-79. The author reports an inefficient use of oil shale as a power-station fuel and recommends its greater utilization as a chemical raw material. The growth of gas and fuel oil as power-station fuels is expected while the use of long-haul steam coals will drop in the next few years.)

The drafting of fuel-and-energy balances for individual economic-geographic regions, as well as for the country as a whole, is an essential prerequisite for the rational development of the electric power and other industries connected with the mining and utilization of fuels.

In accordance with the instructions of the Gosplan (State Planning Committee) USSR on the drafting of a fuel-and-energy balance of the USSR for 1959-65, the compilation of a unified fuel-and-energy balance has now become essential in planning practice.

The receipts and consumption of the principal types of fuel under the Kuybyshev Regional Economic Council in 1958 are shown in Table 1.

The largest share in the consumption of solid fuels (by weight) is made up by Donets, Kuznetsk and Karaganda coals and Kashpir oil shale. An

An important part in the fuel balance of enterprises under the regional economic council is also played by residual fuel oil and natural gas of the gas and oil fields of Kuybyshev Oblast. (Table 1 does not list residual fuel oil -- Editor, S. G.)

Table 1

Type of fuel	Receipts (thousand tons)	Consumption (thousand tons)
Donets coal	683.90	757.60
Moscow coal	0.23	0.11
Kuznetsk coal	207.10	185.50
Chelyabinsk coal	68.80	91.70
Other RSFSR coals	12.60	7.70
Ukrainian brown coals	1.85	2.76
Karaganda coal	110.00	118.90
Tailings	5.90	6.40
Oil shale	1104.50	1089.80
Peat briquettes	0.24	0.15
Peat lumps	0.30	0.46
Firewood	206.90	194.40
Gas (natural and oil-field) (in thousand cu. m.)	406,603	406,603

The fuel balance of the Kuybyshev Economic Administrative Region is characterized by a wide range of solid-fuel grades from various deposits. Despite the gradual increase in the consumption of local fuels (high-sulphur fuel oils, gas and oil shale), the structure of the fuel balance still requires improvement. As shown by Table 2, based on Gosplan data, the most promising types of fuel are natural gas and fuel oil.

Table 2

Types of fuel	Length of haul (in kilometers)	Production costs (in per cent)	Capital investment (in per cent)
Natural gas	300	100	100
Fuel oil	150	120	141
Donets ASh coal	1420	635	196
Kuznetsk coal (from surface mines)	2760	493	247

Note: The production costs include prospecting and transportation.

A large part of the fuel balance of Kuybyshev Oblast is made up of fuel consumed by power-generating installations, as shown by Table 3.

Table 3

Types of fuel	Percentage of power-station fuels in the total fuel balance of the Regional Economic Council
Fuel oil	71.2
Donets coal	58.9
Karaganda coal	2.4
Kuznetsk coal	0.1
Oil shale	95.9
Tailings	29.9
Gas	66.8

The total share of power-station fuel consumed by the Kuybyshev power grid amounts to about 30 per cent (in conventional fuel units) of the total fuel consumption of the Regional Economic Council.

The consumption of long-haul fuel raises transportation costs and thus affects the economic indicators of the power stations. For example, at the Bezymyannaya TETs (teploelektrotsentral' -- central steam-electric station) at Kuybyshev, the transportation of one ton of Donets coal by rail in winter costs 96 (old) rubles; in summer, when coal is shipped by combined rail-water routes (up the Volga from Stalingrad), the transportation cost rises to 106 rubles per ton. The power station's total transportation bill amounted to 2.3 million rubles in 1958.

There is now a plan to convert the Novokuybyshevsk TETs No. 1 to solid fuel. The station has been burning fuel oil since its inauguration in 1951. The fuel oil supply system of the station has been rebuilt and expanded to the full required capacity. The fuel oil is supplied by the oil refinery situated next to the station. The refinery, which ships its refined products from Novokuybyshevsk railroad station, must frequently dump its fuel oil in reservoirs because of overloading of the station's terminal operations, even in summer, when a large part of the oil products is shipped on the Volga River.

The Novokuybyshevsk TETs No. 1 supplies steam to the oil refinery, the synthetic alcohol plant and other enterprises. Conversion of the power station to solid fuel would reduce the reliability of the steam supply for important industrial plants and worsen the economic indicators of power-station operations (the expected deficit is estimated at 14 million rubles a year). In addition to the over-expenditures associated with the conversion of the station to solid fuel, 50 million rubles will be required, including 37 million rubles for the construction of a Volga River coal terminal near Obsharovka railroad station.

It is therefore advisable to keep fuel oil as the principal fuel for the Novokuybyshevsk TETs No. 1.

Oil shales of the Kashpir deposits play an important role in the fuel balance of the electric-power stations.

The principal oil-shale deposits of Kuybyshev Oblast are:

1. Kashpir deposit (on the Volga). Average depth of shale: 46-266 meters; four productive seams; ash content: 42-72 per cent; tar yield: 3-15 per cent; heat value: 1,300-3,100 large Calories per kilogram.

2. Dergunovka deposit (Bol'she-Glushitsa Rayon). Average depth of shale: 0-65 meters; four productive seams; ash content: 47 to 75 per cent; tar yield: 8 per cent; heat value: 1,060-2,110 Cal./kg.

3. Obshchiy Syrt deposit (Bol'she-Chernigovka and Alekseyevka rayons). Eight productive seams; ash content: 45 to 69 per cent; tar yield: 7.5 to 22 per cent; heat value: 1,659-3,675 Cal./kg.

The mining of oil shale began at the Kashpir deposit in 1919. In the early years of the first five-year plan a great deal of attention was given to the development of the oil-shale industry in the Middle Volga valley with a view to strengthening the energy base of the region and using local fuels.

At the end of the first five-year plan (1932), shale output amounted to 120,000 tons. A shale distillery went into operation at Syzran' in 1932-33. In 1956 the Kashpir mine produced 1,206,000 tons of shale and in 1959 more than 1,300,000 tons. The 1965 goal is 2,000,000 tons.

In addition to its use as a chemical raw material, the shale can also be used directly as a power-station fuel and produce gas for industrial and residential needs.

At the present time nearly all the shale (as much as 93 per cent) is used as fuel at the Syzran' TETs. This is an inefficient use of the shale in view of its low heat value, its high ash content and its poor transportability. It would be far more efficient in Kuybyshev Oblast to use natural and oil-field gases and residual fuel oil as power-station fuel, thus changing the structure of the fuel balance of the oblast.

The use of oil shale as a power-station fuel is inefficient even when compared with long-haul coal. The combustible part of the oil shale amounts to only 22-24 per cent; the rest goes into slag and requires additional expense in connection with ash removal. The production cost of a ton of oil shale is 14-16 rubles higher than its wholesale price. A production cost of the equivalent of a conventional-fuel ton of oil shale burned at the Syzran' TETs (including transportation costs) is 210 to 220 rubles while the factory sales price is 145 to 150 rubles. On the other hand, the cost of the equivalent of a conventional-fuel ton of coal (from the Donets Basin or Karaganda) used by the power stations of Kuybyshev Oblast is less than 120 rubles (transport included), in terms of wholesale prices as of July 1, 1955.

A use of oil shale as a power-station fuel is thus quite inefficient in the case of Kuybyshev Oblast. Only 7 to 8 per cent of the oil shale is used as a chemical raw material, largely because of inadequate processing capacity of the shale distillery. In view of the oil shale's primary use as a fuel, the Kashpir mine and the Syzran' TETs have been combined under the jurisdiction of the Power Industry Administration of the Regional Economic Council. Because of this organizational set-up the mine management does not pay enough attention to the quality of the shale sent to the distillery. Shale with a high tar yield (12-14 per cent) is being sent to the Syzran' TETs, and shale with a tar yield two to three times smaller is being sent to the distillery. This procedure reduces the possible output of chemical products of the distillery by about half.

Distillation of the oil shale yields shale tar, pitch and semicoke. The shale tar yields valuable flotation reagents. Chemical processing of the tar also yields pharmaceuticals (sulfichtol, sulfidin), veterinary products (ichtyol, albichtol, thiocreolin), a plasticizer used in the rubber industry and a demulsifier used in the oil industry. Shale-tar pitch is used in the production of acid-resistant plastics (bakelites) and varnishes. Shale ash is used in the production of silica brick, asphalt concrete, mineral wool, and cinder blocks. The shale semicoke yields a special-purpose cement that is almost half as cheap as ordinary cement.

Chemical processing of oil shale is far more efficient than its use as a fuel. For example, one ton of oil shale can yield about 100 kg. of ichtyol, which costs about 258 rubles to produce and is worth 600 rubles (wholesale price as of July 1, 1955); the same amount of oil shale can also yield 67 kg. of plasticizer, which costs about 108 rubles to produce and is worth 122 rubles (wholesale price).

Some oil-shale products, such as ichtyol, are widely used not only in the Soviet economy but in other countries of the Socialist camp as well as in the Near East. (Ichtyol is used as an antiseptic and emollient -- Editor, S. G.). The oil shale of Kuybyshev Oblast should be used mainly as a chemical raw material.

Oil-shale mining can yield at the same time phosphorite that is associated with the shale deposits and can be used for the production of phosphate fertilizer. Joint mining of oil shale and phosphorite would make the operation more economical.

Attention should also be given to the use of the slag of the Kashpir mine and the ashes of the Syzran' TETs in the manufacture of building materials. In 1957-58 the construction projects of Syzran' were about 2 million bricks short each month; there was also a shortage of cement, stone and gravel. The utilization of the by-products of shale processing is therefore of great importance to the state and deserves serious attention on the part of the Kuybyshev regional council.

With a view to improving the present situation in the oil-shale industry of Kuybyshev Oblast, the following steps are necessary:

1. The capacity of the shale distillery must be increased and the use of the shale as a power-station fuel must be restricted to low-tar shale and fines.
2. The Kashpir mine and the distillery must be combined under the same management, charged both with the mining and the processing of the shale.
3. Mine slag and power-station ashes must be used for the manufacture of building materials.

An important objective in the oblast is more rational use of natural gas and of oil-refinery by-products. A major effort is under way to increase the production of natural gas in gas and oil fields. In the current seven-year plan (1959-65) gas production in the oblast is to increase by 3.3 times. Gas pipelines and new natural-gasoline plants are being built.

However there are still shortcomings in the production and use of gas. Chemical plants that are expected to be the principal gas consumers have not yet been completed and gas-separating installations have not been built in the new oil fields. The purification of high-sulphur oil-refining by-products has not been completely achieved. The gas-pipeline network is still inadequate.

Millions of cubic meters of oil-field and high-sulphur oil-refinery gases are still being burned off. At the same time some of the power stations of the oblast are not only continuing but are planning to use long-haul coal as fuel (as in the case of Stavropol' TETs).

In an effort to avoid senseless waste of natural and oil-field gases, the Kuybyshevgaz trust and Pokhvistnevo gas field No. 1 have demonstrated valuable initiative in using exhausted gas deposits as underground reservoirs. In 1958 about 10 million cubic meters of purified gas was pumped into the Bashkatovo deposit. In the winter of 1959 about 4 million cu. m. of that gas was used to supply the city of Buguruslan. At the beginning of June 1959 gas started to be pumped into the exhausted Amanak deposit. The use of the Deryuzhevo and Yablonevo gas deposits is also planned. The use of underground gas reservoirs makes it possible to regulate gas consumption by supplying it in periods of increased demand, and is thus of great economic benefit.

More attention should be given to the expanded use of residual fuel oil in Kuybyshev Oblast. Fuel oil is an efficient fuel on railroads and in small boilers and electric-generating stations. (This also applies to natural and oil-field gas.) The use of these types of fuel tends to reduce power-generating costs, to speed power-station construction and to improve the operational indicators of power stations. It should be borne in mind, however, that power stations using high-sulphur fuel oil pollute the atmosphere with sulphur fumes and that appropriate locations must be found for such

stations. The use of fuel oil as a power-station fuel is also very promising in connection with the current program to desulphurize crude oil directly in the oil fields.

The large share of long-haul coal in Kuybyshev Oblast (especially the Donets ASh grade) is due to a certain extent to the fact that this grade of coal is available and must be used up within the economy.

The long haul of Donets, Kuznetsk, Karaganda and especially of the cheap Siberian coals will steadily decrease as generating capacity is developed in the coal-mining areas. According to Gosplan estimates, the Middle Volga region will be using mainly gas and fuel oil as power-station fuels in five to six years. In this connection the production of high-sulphur crude oil is to be expanded in the Middle Volga, particularly in Tataria and Bashkiria, and refining facilities will be designed to assure a high fuel-oil yield (60 to 65 per cent of the refined products). It should be noted, incidentally, that the fuel oil supplied by the refineries of Kuybyshev Oblast contains less sulphur than the residual fuel oil to be obtained from Tatar and Bashkir crudes.

THE ECONOMIC-GEOGRAPHIC SITUATION OF ORENBURG

By V. S. Varlamov

(From Vestnik Moskovskogo Universiteta, seriya geografiya, 1960, No.6, pp. 55 - 60)

(Abstract: This paper, which supplements another article by V. S. Varlamov, published in Soviet Geography, March 1961, pp. 54-60, analyzes the effect of Orenburg's economic-geographic situation on the city's past, present and future industrial development. The city is found to owe its growth almost entirely to its situation at the crossing of transportation routes linking major raw-material-producing and end-product-consuming regions of the USSR.)

With its population of 267,000, an industrial labor force of 32,000 and a gross industrial output of 3 billion (old) rubles, Orenburg lags far behind the main industrial centers of the Urals. It is, however, of great interest as an object of economic-geographic study distinguished by several unusual features.

Orenburg is interesting, first of all, as a clear example of the outstanding part played by a city's economic-geographic situation. This example is especially good because it demonstrates the effect of economic-geographic situation in its "pure form": other factors, such as physical environment, site, proximity of mineral deposits or historical development, which usually affect the development of a city together with its economic-geographic

situation, play a minor role in this case. (Of course, the most general common features in the development of all cities are determined by social-economic conditions and the over-all history of development of a country. But the economic-geographic situation, physical environment, site and other concrete factors of each city determine its individual characteristics.) In fact, the physical environment, such as mineral, forestry and water resources, played a leading role in the development of most Urals cities based on mining and smelting. No such resources are to be found in the immediate vicinity of Orenburg. As late as the 1870's and 1880's the city did not even have a developed agricultural area around it. In short, the local economic base of Orenburg was so unimportant that it alone could not explain either the past or the present growth of this large city.

The economic-geographic situation of Orenburg is important not only compared with other developmental factors, but in itself; in all stages of the development of Orenburg the most obvious aspect of its situation was its location at the crossing of routes connecting the major economic regions of the country.

A close relationship between the contemporary functions of Orenburg and its economic-geographic situation is typical of the city.

The importance of its economic-geographic situation was already evident at the time of its founding. The city was founded three times in succession at different places. (In 1735 it was founded at the site of the present Orsk, in 1741 at Krasnaya Gora, 180 km. west of Orsk, and in 1743 at its present site.) The principal reason for these site transfers was the need for bringing the economic-geographic situation of Orenburg in line with the policy of annexation of Kazakhstan and the Central Asian khanates, pursued by the Russian Empire at the time of the founding of the city. The principal disadvantage of the first two sites was their almost total isolation from the main Russian territory, the metropolis, hampering both the organization of barter trade and the defense of these sites, as well as the supply of food to these then agriculturally undeveloped areas. It was only at the third site, at the confluence of the Yaik (Ural) and Sakmara rivers, near the source of the Samara (a Volga tributary), that Orenburg finally asserted itself on the shortest route leading from the Volga, then a vital Russian transportation artery, to Kazakhstan and Central Asia(the straight line from Samara, the easternmost penetration of the Volga, to Tashkent led almost exactly through Orenburg).

Having been founded because of the requirements of the "metropolis" of Central Russia, Orenburg functioned as a kind of trading agent for Moscow, Nizhniy Novgorod and Kazan', transferring the riches of the Asian lands to the "metropolis" and serving as a middleman in commercial relations between Central Russia and Kazakhstan-Central Asia. Because of these economic functions on behalf of the metropolis, long-distance connections and a favorable economic-geographic situation were vitally important to Orenburg.

The economic development of Orenburg has been closely related to changes in its economic-geographic situation.

The Samara-Orenburg Railroad, built in 1877, linked the Orenburg region with the Volga and Central Russia, with the principal Russian market, provided a powerful stimulus for the growth of commercial grain production and constituted a major factor of the development of capitalism in the Orenburg region and its transformation into an area of large-scale commercial grain growing. As the terminal of the railroad, Orenburg became the gate to the region and an important grain-trading center where grain flows from many areas converged into one major flow moving by rail to domestic and foreign markets.

The subsequent construction of the Orenburg-Tashkent Railroad in 1905 opened for Orenburg grain a huge new market in Central Asia, thus further stimulating Orenburg's grain trade and turning the city into an important milling center.

In the Soviet period the economic-geographic situation of Orenburg changed substantially, producing profound changes in the city's economic development at various stages.

Orenburg during the civil war and the reconstruction period (1917-27). During the civil war the city acquired great political and strategic importance as the only large proletarian center in the whole area between the Volga and Tashkent and as a link between Central Russia and Turkestan.

In those years the city also gave the politically important assistance of a Russian proletarian center to previously oppressed nationalities, such as the Kazakhs and the Bashkirs. From 1920 to 1925 Orenburg was the capital of Kazakhstan.

Orenburg during the pre-war five-year plans (1928-41). Despite a large increase of industrial output in those years (the city's gross output in 1940 was more than eight times greater than in 1927-28) no basic changes took place in the city's industrial structure. Food processing and light industry remained the leading branches. In 1934 Orenburg became oblast capital.

The growth of heavy industry was slowed in the city by a shortage of fuel and electric power and some aspects of its economic-geographic situation that were characteristic of that stage of development (the city's situation in the middle of a predominantly agricultural area, as part of the Middle Volga Economic Region; its remoteness from the rapidly developing industrial Urals and from the coal base of Karaganda; the absence of large mineral resources near by).

However certain changes that took place during this stage served gradually to improve the economic-geographic situation of Orenburg. These

changes were: the construction of the Magnitogorsk steel mill in 1932; the establishment of a link with the Urals through the construction of the Orsk-Kartaly railroad in 1930 (the Orenburg-Orsk railroad had been built in 1918) and with Karaganda through the construction of the Karaganda-Akmolinsk-Kartaly railroad in 1940-41; the construction of the Sol'-Iletsk-Ural'sk railroad in 1936, and the start of development of the Orsk-Khalilovo industrial area. These changes began to affect the economic development of Orenburg during the next stage.

Orenburg during the Great Patriotic War (1941-45). The changes that had taken place in the city's situation during the preceding stage and other new factors (the remoteness of Orenburg from the fighting front and its situation in the Urals) made possible the leap in the city's economic development that took place during the Great Patriotic War.

As a result of these changes the city was able to attract several large industrial plants evacuated from the western areas and to change its industrial structure from predominantly food-processing and light industry to heavy industry. Orenburg's gross industrial output doubled during the war period. At the end of the war the new industrial plants accounted for three-fifths of the city's industrial production.

Among the new industries were oil refining and rubber fabrication. Among the light industries, new factories (silk milling) were added through evacuation from the west and previous industries (knitwear, footwear) were expanded.

The changes that took place in the economic-geographic situation of the city during the pre-war five-year plans and the war prepared conditions for a thorough change of the economic structure of Orenburg and its participation in the system of intra-regional production links of the Urals. Orenburg thus "passed" from the Middle Volga region, of which it had been a part at the beginning of the five-year plans and which was then mainly an agricultural region, to the Urals economic region. Orenburg became one of the principal industrial centers of the Urals.

The post-war development of Orenburg (after 1945). In recent years Orenburg has continued to grow as a diversified city with industrial, transport, economic-organizational, administrative and cultural functions.

In 1959 the gross industrial output of Orenburg exceeded the 1946 level by 4.1 times, the 1940 level by 6.6 times and the 1913 level by 111 times. (Approximate figures can be derived as follows: 1940 - .45 billion rubles; 1946 - .73 billion; 1956 - 2.4 billion; 1959 - 3 billion rubles -- Editor, S. G.)

Typical of this period is Orenburg's growing utilization of its advantageous economic-geographic situation. This process has been expressed, for example, through the rapid growth of Orenburg machine building, due in part to the fact

that Orenburg lies on one of the routes linking the Urals steel mills (for example, Magnitogorsk and Novo-Troitsk) with the European part of the USSR.

Of importance at this stage has also been the strengthening of Orenburg's fuel and energy supply through the development of the Southern Urals lignite basin in Bashkiria.

Orenburg is situated at the crossing of major routes linking, first, the Center, the Volga and other European regions of the USSR with Kazakhstan and Central Asia (through the railroad Moscow-Kuybyshev-Orenburg-Tashkent); second, the European part of the USSR with the eastern areas of the Soviet Union -- the southern Urals, Siberia, northern and central Kazakhstan (the railroad Moscow-Orenburg-Orsk-Kartaly and eastward; pending construction of the Magnitogorsk-Chishmy railroad, this route provides the shortest link between the South Siberian Railroad and the European part of the USSR); third, the Urals with Kazakhstan and Central Asia (the railroad Sverdlovsk-Orsk-Orenburg-Tashkent; it is true that since 1944 there is a more direct connection by-passing Orenburg through Orsk-Kandagach; however in the long run, after construction of the Orenburg-Ufa-Perm' railroad, Orenburg will again be situated on a major line linking the entire western Urals with western and southern Kazakhstan and Central Asia).

(Editor's note, S. G. Magnitogorsk-Chishmy appears to be the latest decision on the alignment of the western end of the South Siberian Railroad through the Bashkir ASSR. The planned alignment of the railroad west of Magnitogorsk has undergone many changes in the post-war period. In recent years the alignment appeared to have narrowed down to Magnitogorsk-Beloretsk-Sterlitamak-Abdulino. A source published in early 1960 (V. N. Kuznetsov, Transport Bashkirii, Bashkir Publishing House, Ufa) mentions two alternatives: Sterlitamak-Abdulino and Sterlitamak-Rayevskiy (pp. 37-38). However, the information on the Magnitogorsk-Chishmy alignment, evidently by-passing Sterlitamak, is confirmed by an authoritative statement by B. P. Beshchev, Railroad Minister, in Zheleznodorozhnyy transport SSSR v 1959-65 gg. (Railroad Transportation in the USSR in 1959-65), Moscow, Gospolitizdat, 1960, p. 61, that "the western part of the South Siberian Railroad, to be completed in 1959-65, will go from Magnitogorsk through Beloretsk to the Ufa area." Chishmy, 48 rail kilometers west of Ufa, is a particularly favorable terminus because it is situated at the junction of railroads going west to Kuybyshev and Ul'yanovsk. The construction of the railroad west of Magnitogorsk is made difficult by the presence of parallel north-south ranges of the southern Urals. The construction of the Magnitogorsk-Beloretsk section was virtually completed in 1959.)

Orenburg is also favorably situated with respect to a local agricultural region and with respect to markets for agricultural products.

Various industries arose and developed in Orenburg based on the

utilization of the various favorable aspects of the city's economic-geographic situation. The following pairs of regions are linked by routes passing through Orenburg: (1) the European and eastern regions of the USSR; (2) the European and Central Asian-Kazakhstan regions; (3) the Urals and the Central Asian-Kazakhstan regions. Orenburg's industries receive raw materials and semi-finished goods from one member of such a regional pair and sell the finished products to the other member. The city's principal industries thus function as middlemen in the inter-regional division of labor and in the commerce between the paired regions, among which Orenburg occupies a central position.

For example, the machine-building and metal-fabricating plants of Orenburg receive three-fourths of their iron and steel from the steel mills of the Urals and ship most of their finished products to the European part of the country.

Oil products requiring further processing arrive at Orenburg from the west, and the refined products are shipped mainly eastward. Ozocerite is received in Orenburg from Central Asia, and its finished products are sold in the European parts of the country.

The city's economic-geographic situation has determined not only the industrial structure of Orenburg but also the character of its economic links. (See V. S. Varlamov, "On the Economic Links of the Industry of Orenburg," Geografiya i Khozyaystvo, No. 3-4, 1958, translated in Soviet Geography, March 1961, pp. 54-60.) The economic-geographic situation of the city is also expected to be a strong factor in its future development.

The construction of the Magnitogorsk-Chishmy railroad will make possible shipments of Magnitogorsk steel directly westward, by-passing Orenburg. But this will not affect the prospects of Orenburg's metal-fabricating industry because: (1) part of the Magnitogorsk steel will continue to be shipped through Orenburg; (2) a new steel plant is rapidly expanding at Novo-Troitsk, in Orenburg's backyard. If the establishment of rail connections with Magnitogorsk and Karaganda once brought about a real leap forward in the industrial development of Orenburg, then the growth of a local steel base at Novo-Troitsk will also undoubtedly open new prospects for the expansion of Orenburg's machine-building and metal-fabricating industries. (The rail distance between Novo-Troitsk and Orenburg is 330 km. For comparison, the rail distances between two other pairs of steel and machinery centers are: Stalino-Khar'kov 320 km.; Stalinsk-Novosibirsk - 449 km.)

Orenburg's metal-fabricating industry will also be supplied by an expanding nonferrous metals base with the growth of the Mednogorsk copper-sulphur mill and of the Orsk nickel plant, and the construction of the Gay copper-mining center and the Buruktal nickel mill. (See Soviet Geography, May 1960, p. 88, and November 1960, p. 76, for further details on Gay; June 1960, p. 77, and January 1961, p. 79, on Buruktal-Svetlyy.)

The growing supply of ferrous and nonferrous metals in the eastern regions of the USSR makes it advisable to locate in Orenburg new metal-fabricating industries, such as special machine-building plants using the alloy steels of Novo-Troitsk, and factories producing instruments, electrical goods, automation equipment and so forth. (It is important to point out that Orenburg is situated on the main route from the new ferrous and nonferrous metal bases of the East to the European part of the USSR, which will for a long time yet be the principal market for metals and machinery.)

Orenburg also lies on the shortest route linking the Ukraine and the entire southern European part of the USSR with the southern Urals, Siberia and northern and central Kazakhstan. This locational factor will become even more important with the construction of a trunk railroad connecting these regions, either in the form of a Donets-Kuzbas-Amur railroad through Odessa-Donbas-Stalingrad-Orenburg-Kartaly (Magnitogorsk), linking all the major existing or planned coal-steel centers of the USSR, or in some other form such as the Middle Siberian Railroad (Barnaul-Kokchetav-Kustanay-Aydyrlya) connecting with Orsk-Orenburg and continuing possibly via a branch from the Orenburg-Buzuluk railroad to the Volga. With the completion of such a super-railroad Orenburg will be in an even more favorable position at the crossing of the railroads Moscow-Tashkent and Donbas-Magnitogorsk-Abakan (continuing to the Angara, Baykal and Amur). Orenburg's location at the crossing of trunk lines that would form, together with a few other railroads, the basic rail net of the USSR and would connect the principal industrial regions of the country would create favorable conditions for the continued economic growth of Orenburg.

The city's location between Kazakhstan-Central Asia, which supply raw material for light industry, on the one hand, and the Urals with its huge market for light industrial products, on the other, will also promote the further growth of Orenburg's light industry. Other factors promoting light industry are the presence of a substantial local raw-material base, the availability of skilled manpower and the existence of appropriate educational institutions.

The transformation of Kazakhstan into a large grain-producing zone and the growth of population in the virgin lands will favor the production of agricultural machines and consumer goods in Orenburg.

Another major factor in the future development of Orenburg is the rapid growth of the Volga-Urals oil region, which is gradually expanding onto the territory of Orenburg Oblast. The entire western part of the oblast, including the approaches to Orenburg city and extending to the Urals folded mountain country, is a prospective oil and gas-bearing area (Trudy VNIGRI (Proceedings of the All-Union Geological Exploration Research Institute), No. 104. The Volga-Urals Oil-Bearing Province (Its Oil-Bearing Potential), Leningrad, 1957). In terms of potential oil and gas reserves, Orenburg Oblast is believed to be on the same level as such important oil-producing areas as Bashkiria and Kuybyshev Oblast (see V. N. Nurshanov,

"The prospects of development of the oil industry in the Orenburg economic administrative region," Planovoye khozyaystvo, 1959, No. 5). The development of oil and gas production in the western part of Orenburg Oblast and the further growth of the Southern Urals lignite basin would provide a firm fuel and energy base for Orenburg's industries and the foundation for petrochemical and coal-chemical industries.

Orenburg's example clearly illustrates the importance of economic-geographic situation for the development of a city. The correct utilization of locational characteristics can yield considerable material benefits; in the given case virtually all of Orenburg's industries arose and developed on the basis of the city's favorable economic-geographic situation.

In the present decisive stage of economic competition with capitalism, great importance is attached to the utilization of all reserve potentials of raising the social productivity of labor. One of these potentials, which may be of great benefit to the national economy, is the careful analysis and complete and purposeful utilization of economic-geographic situation in the planned development of each city and region of the USSR.

THE GEOGRAPHY OF INDUSTRY IN THE UNITED STATES

By V. M. Gokhman

(From Voprosy Geografii, No. 44, 1958, pp. 114-34)

(Abstract: This review article surveys American work on the geography of industry from the point of view of five lines of research: (1) the development of a general theory of industrial location; (2) the geography of manufacturing as a whole and the delimitation of manufacturing districts; (3) the geography of individual industries; (4) study of individual industrial districts and centers; and (5) the effect of technological change on the geography of industry.)

The present state of economic geography in the United States is characterized by a growing division into narrower disciplines. This has prompted some American economic geographers to say that "general economic geography ceased to exist as a research specialty, if, indeed, it could ever have been so regarded." (American Geography, Inventory and Prospect, Syracuse, 1954). It seems to us that such a statement is exaggerated and does not correspond to the real state of things, including the present trend of geographic research in the United States, where a wide range of economic geography studies are being published. Among them are books of the compilation type (designed mainly for teaching), but there are also many original studies on general economic geography. In particular, many studies are devoted to research methods common to all economic-geographic disciplines as well as to the integrated study of specific areas.

At the same time there can be no doubt that together with a growth of general economic geography there has been a greater expansion of particular economic-geographic disciplines concerned with the geography of individual branches of production and individual types of economic activity. The growth of the particular disciplines is related mainly to the fact that various types of human activity have their specific features; thorough study of such activities requires special knowledge in the fields of technology, economics, marketing and other adjacent sciences and at the same time confronts researchers with special theoretical and practical problems. As the economy and technical progress continue to grow, the specific characteristics of segments of the economy become more evident and the number of their specific problems increases.

Of all the particular economic geographic disciplines (in addition to the geography of individual segments of the economy, we also include various aspects of population geography), the one that has been most highly developed in the United States is probably the geography of agriculture, a branch that is closely linked to natural conditions and at the same time is most suitable for the use of special geographical methods of analysis, including mapping. But in the last thirty to forty years, the geography of industry (particularly of manufacturing) has also become an independent field of research in the United States. An increasing number of studies is being published in this field; in terms of the number of studies, it has outdistanced the other particular economic-geographic disciplines, with the exception of the geography of agriculture.

The development of the geography of industry in the United States is linked to a large degree with the practical needs of the present-day capitalist economy. The main moving force in the development of production under capitalist conditions is the desire of entrepreneurs to achieve a maximum profit. (This is acknowledged by many bourgeois economists and economic geographers. See, for example, the review of M. Greenhut's Plant Location in Theory and in Practise Chapel Hill, 1956, in the April 1957 issue of Economic Geography, or the study by McCarty and his associates on The Measurement of Association in Industrial Geography, Iowa City, 1956, p.3.) One of the principal factors determining the amount of profits is the choice of plant location. This is especially important for large countries, such as the United States. In the present stage of capitalist development, when production is dominated by monopolistic companies whose interests cover the entire country, the choice of location for the construction of new plants, especially large ones, has generally ceased to be the result, to a certain extent, of accidental circumstances, such as was often true in the pre-monopolistic period. A small entrepreneur is usually limited in his choice of plant location; large monopolistic companies, on the other hand, have greater, virtually unlimited choice. They seek to find a location that will yield the greatest profits. And the search for such a location involves serious economic and economic-geographic analysis.

The correct approach to the problem of plant location requires information on factors affecting its cost of operation, i.e., in other words, the factors of location of the given branch of production. Proper understanding of those factors, in turn, requires knowledge of the general theory of location of production. The practical needs of development of the economy thus stimulate interest in theoretical studies on the location of production and locational types and their determinant factors. At the same time there is a need for statistical and field work designed to verify the findings obtained through theoretical studies.

Important considerations in plant location are not only the factors of location of the given industry as a whole, but also the location of existing plants of that industry and of related industries. This in turn requires study of the geography of the corresponding industries and consideration of the changes that take place in them. But the practical aspects of the geography of industry do not end there.

Industry is a predominantly urban segment of the economy; in many cities it is the principal source of livelihood of the population; the conditions and amount of industrial production determine to a large extent the income of local authorities, which are therefore also interested in the geography of industry. The geography of industry, as a scholarly discipline, is thus close to urban geography; jointly the two solve such problems as the economic basis of cities and their types, the functional classification of cities, and so forth.

Finally, many government agencies also have a need for data on the location of industry and on the factors that enter into it. Under Franklin D. Rossevelt, the need for such information was related to some extent to efforts to regulate the economy; since World War II strategic considerations have acquired greater importance, for example, a desire to disperse defense industries and to promote their location in the militarily less vulnerable interior areas. The participation of specialists in the geography of industry is also useful in the solution of those problems.

A wide range of groups thus share a certain interest in promoting the geography of industry in the United States. Judging from scanty available data, the geography of industry is among the geographic (and not only geographic) disciplines best represented among graduates that enter on practical rather than teaching careers. (This was confirmed by Professor Chauncy D. Harris of the University of Chicago at the time of his visit to the Institute of Geography of the Academy of Sciences USSR in June 1957. A prominent American economic geographer, he is the author of the chapter on the geography of manufacturing in American Geography.) Specialists in the geography of industry can be found in many government agencies, including the Bureau of the Census, the Department of Interior, the Department of Defense, and so forth, as well as in state and city agencies. Special departments concerned with the location of production have also been set up in several large companies (such as Ford, General Motors,

General Electric); in addition to other specialists, these departments often employ also geographers. Finally there are special consulting firms who engage in contract work for companies that do not have their own plant-location departments, advising them on the choice of plant sites and on other problems relating to industrial location.

The need for qualified specialists in the geography of industry prompted some American universities (including Chicago) in recent years to offer expanded special courses on the geography of manufacturing; there has been a noticeable increase in the number of dissertations in that field (especially at Chicago and Clark).

All this time, however, there has not been published in the United States a single major work devoted to the geography of industry as a whole or at least to the geography of its major branches (for example, heavy industry or, to take a narrower field, machine building); nor has there been a major study of the changes that have taken place in the geography of industry in the wartime and post-war years. (Changes in the distribution of industry as a whole have been covered in a few relatively short articles that yield only a very generalized picture. Among these articles is John W. Alexander's "Industrial Expansion in the United States, 1939-47," Economic Geography, 1952, No. 2.) The principal reason for this lack of major study is apparently that such a project, involving a great deal of time and energy, is of less immediate practical interest.

In concerning themselves with problems of industrial location, geographers come in close contact with economists. However, there are substantial differences in their approaches to this kind of problem in the United States. The economist usually starts with a study of the price-forming factors in the given industry or group of industries. On that basis he tries to establish differences in price levels in various areas or points and, on the basis of those differences, he offers his own suggestions regarding optimum plant location in the given industry. He then tests those suggestions by applying them to a specific area and comparing his theoretical findings with the actual situation in the field.

The geographer, on the other hand, usually starts with a study of the actual location of production and only later tries to explain it. As far as can be judged from their articles, American geographers use two approaches in their work on the geography of industry: (1) the study of spatial links of a single plant or a single industry; or (2) the study of areas in which manufacturing is the principal segment of the economy. In both cases they try mainly to uncover the spatial links and combinations of factors as well as the processes that determine the development of industry in the given area (see also the chapter on the geography of manufacturing written by Harris for American Geography).

In order to increase the practical value of their work, American geographers and economists in the industrial location field try as far as possible not to

limit themselves to a purely qualitative approach, but to assign quantitative characteristics to the studied phenomena and processes with a view to endowing the results of the research with a more specific character, expressed in figures or formulas. In addition, attempts have started in recent years in the United States to use methods of mathematical analysis, mainly mathematical statistics and the theory of probability, in the geography of industry (and, incidentally, in economic geography in general). The authors of several studies try to establish coefficients of correlation, association, localization and so forth for the studied phenomena. (Among studies of this type is the above-mentioned book by Harold H. McCarty, John C. Hook and Duane S. Knos, The Measurement of Association in Industrial Geography, Iowa City, 1956. Other studies are: National Resources Planning Board, Industrial Location and National Resources, Washington, 1943, and John H. Thompson,"A New Method for Measuring Manufacturing," Annals of the Association of American Geographers, 1955, No. 4.) The fact that such research, which usually involves a great deal of computing work and sometimes the use of modern calculating machines, is not in any way abstract or theoretical is shown, in part, by the nature of the financing sources. (For example, McCarty's study was financed by the Office of Naval Research.)

These first attempts to apply methods of mathematical analysis, already used more or less by specialists in other social sciences, are to a large extent purely statistical in character; nevertheless they are of a certain interest because they demonstrate a desire to raise economic geography to a higher level and to transform it from a predominantly descriptive science into an analytical science. This desire is promoted by an appreciation of the practical value of such work.

A desire to use as far as possible quantitative methods of analysis is inherent in all natural and social sciences; however, thus far little has been done in that respect in economic geography. In order to make greater progress in that field, American economic geographers concentrate increasingly on the question of what quantitative criteria can be used for characterizing the location of industrial production, its relative importance in studied centers or areas, and for comparing rates of development in various places, and they try to establish statistical indices of localization, dispersion or territorial combination of various industries.

Sources of Factual Data. Success in the field of economic geography, and often the actual possibility of working in that area, depends to a large degree on the availability of factual data. For the study of industrial location in the United States, American economic geographers are able to use three basic sources of data: (1) the results of field work (either their own or that of colleagues in the profession) (field work is understood here in its broadest sense, including study of company reports, archives and so forth); (2) official statistical publications, especially census publications, and (3) the published literature, including periodicals. Usually the smaller the study area, the greater the possibilities for field work and the more the researcher is obliged to rely on the findings of such field work, for published

statistical data for small areas are very limited, if available at all. On the other hand, when the object of study is a large region or the United States as a whole, available statistical data play a dominant role.

The principal source of statistical data in the United States is the Bureau of the Census. (Other government agencies also collect and publish statistical data. Some states publish their own statistical handbooks that can be used to supplement the Federal publications. Finally, statistical data are also published by trade associations, such as the American Iron and Steel Institute and the Bituminous Coal Institute.) The most useful data for study of the location of manufacturing are the results of censuses of manufactures. At first these censuses were conducted once every ten years together with the population censuses. Between the two world wars censuses of manufactures were conducted every two years. None was held during World War II (more precisely from 1939 to 1947). Current legislation calls for the holding of censuses of manufacturing(and of several other segments of the economy) once every five years; in addition selective statistical surveys of industry have been conducted almost annually since 1949.

The basic enumeration unit in censuses of manufacturing is the factory. The enumeration data are combined by administrative units (cities, counties, states) and special statistical units (census districts, metropolitan areas). The publications of the census of manufactures contain data on the number of establishments, the number of persons employed, the gross and net value of output, the wage bill, the cost of raw materials and electric power, and other production indices. The appropriate data are reported by each enterprise; however, existing legislation prohibits the publication of data from which information on the activity of individual companies could be derived. (Therefore, in cases where a given territorial unit contains only one, two or, in some cases, several enterprises of a given industry, no data covering that area are published.) In practice this means that the publications of the census of manufactures contain many blanks, not only for small areas, such as counties, but also for states and even census districts.

That circumstance, combined with a certain incompleteness of data (only privately owned enterprises are enumerated), reduces the value of the census of manufactures, especially for small areas.

A disadvantage of the standard classification of industries (and, incidentally, of previously used classifications) from the geographer's point of view is that it is based on technological and commodity considerations, so that industries are combined into groups on the principle of common sources of raw materials and similarity of production process rather than according to markets or common locational factors. For example, one of the industry groups includes such disparate industries as the production of construction steel and the making of tin cans. The localization of these two industries should be quite different since the metal-oriented construction-steel industry is generally concentrated in steel centers and the making of light, fragile and bulky cans is best located near the consumers. However,

published data often combine these unlike industries under statistical headings that cannot be broken down into separate industries.

For work on the geography of industry it would in many cases be much more convenient if, say, the production of cans were combined into an industry group with the production of other types of containers for canned goods, in other words, if the common purpose of the product and the similarity of localization were taken into account. However, such a classification is not being used anywhere, and geographers studying industrial location must use data grouped according to less convenient classifications.

Basic research trends in the geography of industry in the United States. Individual studies in industrial location were published in the United States as early as the 19th century. As capitalism passed into its monopolistic stage and the demand for studies in industrial location rose, there was also an increase in interest among economic geographers in that type of research, and the number of such studies began to increase gradually. However in the first quarter of the 20th century these studies were not yet systematic in character; they were usually concerned with factors affecting industrial location within individual areas.

The geography of industry was established in the United States as a separate research discipline at the start of the second quarter of the 20th century. Without saying so directly, Harris puts the birth of the geography of industry in the United States in 1927, when "three major papers marked the beginning of present methods in manufacturing geography" (American Geography, Inventory and Prospect, Chapter 12). In one of these articles, Sten De Geer, a Swede, for the first time tried to identify on the basis of quantitative indices and to map the principal area of concentration of the manufacturing industry in the United States, the so-called manufacturing belt ("The American Manufacturing Belt," Geografiska Annaler, 1927, Vol. 9, p. 23); in another Richard Hartshorne attempted to give the basis for a quantitative theory of location of the manufacturing industry("Location as a Factor in Geography," Annals of the Association of American Geographers, 1927, Vol. 17, p. 92); and in a third Robert S. Platt worked out a geographical classification of branches of production based on the types of location ("A Classification of Manufactures Exemplified by Porto Rican Industries," Annals of the Association of American Geographers, 1927, Vol. 17, p. 79). About the same time began more or less systematic work on the geography of individual industries and their locational factors, particularly the iron-and-steel and the cotton-milling industries. (In iron and steel: John B. Appleton, The Iron and Steel Industry of the Calumet District; a Study in Economic Geography, Urbana, 1927; Richard Hartshorne, "Location Factors in the Iron and Steel Industry," Economic Geography, 1928, Vol. 4, p. 241; a series of articles by C. Langdon White, starting with "The Iron and Steel Industry of the Pittsburgh District," Economic Geography, 1928, Vol. 4, p. 113. In the textile industry: H. Wilbur, "Cotton Manufacturing in the South," Journal of Geography, 1927, Vol. 26, p. 1; Robert M. Brown, "Cotton Manufacturing: North and South,"

Economic Geography, 1928, Vol. 4, p. 74; J. Bynum, "Piedmont North Carolina and Textile Production," Economic Geography, 1928, Vol. 4, p. 232.) Finally, in 1929, there appeared in the United States a translation of Alfred Weber's Theory of the Location of Industries, Chicago, 1929, which had been published in Germany before World War I and was to have great influence on the views of American economists and economic geographers in that field.

In the 30 years that have passed since that time, the geography of industry has taken its place among the other branches of economic geography and a large number of studies have appeared in that field in the United States. (A detailed bibliography of studies on the geography of manufacturing and related disciplines published in the United States up to 1952 has been compiled by Professor Harris and published in mimeographed form by the University of Chicago. It contains 250 titles. A shorter bibliography of 70 titles has been included in the chapter on the geography of manufacturing in American Geography.)These studies touch on a wide range of problems related in one way or another to industrial location. We will discuss some of the more important fields of research in the geography of industry in the United States. They are: (1) work on the formulation of a general theory of industrial location and on location types and factors; (2) study of the location of manufacturing as a whole; identification of industrial districts and the use of quantitative criteria for such delimitation; (3) study of the location of individual industries and the determining factors; (4) study of individual industrial districts and centers of industrial concentration, and (5) analysis of the effect on industrial location of such factors as technical progress, the development of new production processes, the discovery of new raw materials and sources of energy, and the appearance of new branches of production and new products.

1. Theory of Location. In this field American economists and economic geographers have been using to a large extent the ideas advanced by Europeans, especially German scholars.

In the first stage of development of the geography of industry, American geographers often resorted to the then widespread school of geographical determinism in their attempts to explain location. However, even before World War I, there appeared several studies whose authors adopted a somewhat different position. (As an example we cite R. Whitbeck, "Specialization in Industry by Certain Cities, With Particular Reference to Trenton, N.J.," Journal of Geography, 1909, Vol. 8, p. 32, in which the author refutes environmentalist views on the factors of location of certain industries, in particular the view that the development of the ceramic industry in Trenton is related mainly to the near-by presence of kaolin.)

After World War I the "Standortstheorie" was widely accepted in the United States. Specialists in industrial location came under the influence of Alfred Weber, an English translation of whose basic work appeared in Chicago in 1929 with detailed notes by C. J. Friedrich. However Weber's

ideas were evident in the work of some American geographers even before publication of the translation (see, for example, the above-mentioned article by Hartshorne). Also widespread in the United States was the book of another proponent of the "Standort" problem, a follower of Weber's views, the Swede Tord Palander (Beiträge zur Standortstheorie, Uppsala, 1935). In the United States, the "Standortstheorie" was developed most systematically by Edgar M. Hoover, whose most important work, The Location of Economic Activities, appeared in 1948 and is constantly cited in American studies on industrial location.

Since World War II, the "Standortstheorie" of Weber has been joined in the United States by the ideas of another German scholar, August Lösch, who takes the market area as his starting point rather than the individual industrial establishment, as does Weber. (Lösch's principal work, Die räumliche Ordnung der Wirtschaft, came out in Germany in two editions, in 1940 and in 1944. Its English translation was published in 1954 under the title The Economics of Location. A Russian translation is being published by the Foreign Languages Publishing House.) The most zealous proponent of Lösch's ideas in the United States is Walter Isard. (Among his many publications, we cite "The General Theory of Location and Space Economy," Quarterly Journal of Economics, 1949, Vol. 63, No. 4; "Distance Inputs and the Space Economy," same journal, 1951, Vol. 64, Nos. 2-3; "Interregional and Regional Input-Output Analysis: a Model of Space Economy," The Review of Economics and Statistics, 1951, Vol. 33, No. 4.)

In recent years attempts have been made to combine the ideas of Weber and Lösch and to formulate a single theory of industrial location on that basis. (Such attempts have been made In the books: M. Greenhut, Plant Location in Theory and in Practice, Chapel Hill, 1956, and W. Isard, Location and Space Economy: a General Theory Relating to Industrial Location, Market Areas, Trade and Urban Structure, New York, 1956. In addition both books treat in detail the history of development of these theories and their present status in the United States.)

It should be noted that repeated attempts to apply a general theory of industrial location to specific practical problems have in general not been fruitful. This is acknowledged by American economic geographers themselves. (For example, Harris ends his section on the theory of location in his chapter on the geography of manufacturing with the acknowledgment that "much work remains to be done, however, to bridge the gap between economic theory and the actual observed distributions;" see American Geography: Inventory and Prospect .)

In addition to efforts to formulate a general theory of location, a great deal of attention is being devoted in the United States to identifying the basic factors in the location of manufacturing. Various authors list among those factors the sources of raw materials, energy and fuel, the labor force, proximity to markets, the existence of transport links with raw-material

sources and with markets, the availability of capital, and others. A comparative evaluation of some of these factors was made by Walter S. Tower as early as 1911 ("Some Factors Influencing the Location and Migration of Industries," Bulletin of the Geographical Society of Philadelphia, 1911, Vol. 9, p. 64.) In 1921 Malcolm Keir stressed the importance of economic factors in the location of manufacturing ("Economic Factors in the Location of Manufacturing Industries," Annals of the American Academy of Political and Social Science, 1931, Vol. 97, p.83). Basing himself on Weber's ideas, Hartshorne proposed a method in 1927 for a quantitative evaluation of the relative weight of the locational factors of labor force, market, raw materials and energy. He also developed the concept of "relative locus" and stressed the importance of the latter ("Location Factors...," op. cit.).

Among individual industrial-location factors, American economists and economic geographers have concentrated their attention on the market factor. We cite Harris' article "The Market as a Factor in the Localization of Industry in the United States," Annals of the Association of American Geographers, 1954, Vol. 44, No. 4, p. 315, in which the author, in addition to a general treatment of the problem, tries to establish the location of the market (i.e., the demand) and how it is reflected in commodity sales in the United States, and attempts to introduce quantitative criteria showing the relative advantages of individual areas and industrial centers with respect to that market.

For such indices he proposes the "market potential" (P) and the "relative transport costs" (T). The market potential of any point is determined, according to Harris, by the formula $P=\sum M(d)$, where M is the magnitude of the purchasing power of each market where the output of the given point could theoretically be sold, and d is the distance between that point and each market. Taking all the counties of the United States as markets and selecting definite indices for measuring M and D, Harris obtains a quantitative expression for the market potential of several cities of the United States. Taking the potential for one of them (in this case, New York) as 100 and assigning relative values to the market potentials of the other cities, Harris compiled cartograms showing the distribution of the market potential in the United States by means of isolines (lines of equal potential) and making it possible to determine the magnitude of the market potential for any point of the United States. He performs similar operations with the relative transport costs which he defines as the sum of the costs of shipping goods from any given point to all selected markets (this sum is calculated by the formula $T=\sum(Md)$ where M and d have the same values as in the market potential formula), related to the sum of any one point taken as 100. Taking large regions instead of the United States as a whole, Harris constructs regional cartograms of market potential "fields" (to use a term in physics) and relative transport-cost fields.

In 1947 George T. Renner underscored the importance of the factor of industrial agglomeration in industrial location ("Geography of Industrial

Localization," Economic Geography, 1947, Vol. 23, p. 167). He introduced the concept of the existence of two types of agglomerations (which he called conjunctive and disjunctive symbioses). In agglomerations of the first type there are functional interrelationships between industries associated within the study area; such interrelationships are lacking in agglomerations of the second type.

A few studies are devoted to the factor of inertia, i.e., a desire of entrepreneurs to keep or to expand existing enterprises in order not to depreciate their invested capital. (Among these studies we cite: Allan Rodgers, "Industrial Inertia, a Major Factor in the Location of the Steel Industry in the United States," Geographical Review, 1952, Vol. 42, p. 56.)

One study also suggested the existence of centrifugal and centripetal forces affecting the localization of various industries (Charles C. Colby, "Centrifugal and Centripetal Forces in Urban Geography," Annals of the Association of American Geographers, 1933, Vol. 23, No. 1).

Industrial-location types have been studied in parallel with location factors. The first attempt to work out a classification of industries based on location types was made by Platt in the above-mentioned article on Puerto Rican industries, dating from 1927. Later McCarty proposed a classification of Iowan industries based on the principal location factors ("Manufacturing Trends in Iowa," Iowa Studies in Business, Vol. 8, 1930). McCarty distinguished industries oriented toward raw-material sources, energy sources, the availability of labor force, the proximity of a market, and, finally, industries whose location was affected by two or more of these factors. These views won wide acceptance in the United States.

Much attention was devoted to location factors and types in a series of studies published under the presidency of Franklin D. Roosevelt by the National Resources Committee (for example, U. S. National Resources Committee, Energy Resources and National Policy, Washington, 1939, and U. S. National Resources Planning Board, Industrial Location and National Resources, Washington, 1943. Location factors are also treated in some booklets published after World War II by the Department of Commerce). The National Resources Committee investigated the successive stages in the production processes of several plants, from raw material to finished product, and came to the conclusion that plants engaged in the initial stages of production are usually situated near raw-material sources while plants engaged in the final manufacturing stages are generally market-oriented (see, U.S. National Resources Committee, The Structure of the American Economy, Part 1: Basic Characteristics, Washington, 1939).

2. The Distribution of the Manufacturing Industry as a Whole and the Delimitation of Industrial Districts. The work of American geographers in this field of research has been linked to a large degree with the study of the so-called manufacturing belt of the United States. It is well known that

most of the manufacturing is concentrated in a relatively small area of the Northeast, including part of New England, the Middle Atlantic States and the Northeast Central states. However, where are the precise limits of the manufacturing belt and what quantitative criteria should be used to delimit it? After all, without knowing the limits of the manufacturing belt, we cannot map it. In addition American economic geographers are confronted with the problem of identifying and mapping secondary manufacturing districts outside the principal belt. And since industrial location is constantly changing, methods must be developed to measure and map those changes.

The pioneer in developing a quantitative approach to the delimitation of the manufacturing belt of the United States was not an American, but the Swedish geographer Sten De Geer, whose study, published in 1927, we have already mentioned. Using available statistical data, De Geer selected as his basic index the number of industrial workers engaged in manufacturing in cities with a population of more than 10,000. Only those cities with at least 1,000 employed in manufacturing were considered industrial.

After De Geer, several American geographers concerned themselves with the problem of delimiting industrial districts. They questioned substantial features of his work, including, first, the limiting of data to cities with a population of more than 10,000, since many industrial plants are situated in smaller places and in suburbs; second, the use of the same quantitative criterion (the presence of at least 1,000 industrial workers engaged in manufacturing) for cities of various sizes (under this system virtually all large cities were considered as industrial even if industry played a relatively minor role while many smaller truly industrial cities were not included), and, finally, the limiting of data to the number of employed persons.

In an effort to overcome the first shortcoming, some American geographers included, in addition to cities of more than 10,000 population, data on major manufacturing districts identified in the census of manufacturing, and thus covered the suburban areas of the large cities of the United States (see, for example, Alfred J. Wright, "Manufacturing Districts of the United States," Economic Geography, 1938, No. 14, p. 195). However, as was noted in 1938 by Clarence F. Jones, even in that case the 10,000 population limit resulted in several of the less industrialized states in the exclusion of a large part of the manufacturing industry, for example, more than half in South Carolina, and two-fifths in Texas ("Areal Distribution of Manufacturing in the United States," Economic Geography, 1938, Vol.14, p. 217). Therefore many authors prefer to use county data, yielding a more accurate picture of industrial location. (Besides Jones, county data have been used by Mc Carty and Strong. See Helen M. Strong, "Regions of Manufacturing Intensity in the United States," Annals of the Association of American Geographers, 1937, Vol. 27, p. 23.)

For determining the distribution of industry American geographers make use of a variety of quantitative indices, including data on the number of industrial workers and the total number of persons engaged in manufacturing,

the gross and net value of output, the wage bill, the consumption of energy and, for some industries, the physical volume of production, installed production capacity and the area of the industrial plant.

Some geographers regard labor-force data as the most accurate measure of industrial location. Hartshorne gives them priority because, in his view, these data provide the best indication of the number of persons for whom a given employment constitutes the means of existence. The United States publishes data on both the number of industrial workers and the total number of workers employed in industry; experience has shown that total employment data yield a more accurate picture because the percentage of persons not engaged in actual industrial production varies widely with industries. The total number of persons employed in industry is almost the only measure that can be used in studying the development of industry as a whole or its major branches over time.

Another group of American geographers, including Alfred Wright, McCarty and Roterus, prefer data on value added by manufacturing (that is the net value of output) on the ground that it is the best generalized index of the total cost of production, including labor, energy and invested capital.

In 1937 Strong compiled a map of the manufacturing industry of the United States, based on energy consumption by counties (Strong, op. cit.). However in the view of most scholars concerned with these questions, energy consumption data are not a good measure of the volume of manufacturing because energy consumption per person and per unit of output varies widely with industries.

Each of these indices, taken alone, has its weaknesses; the use of different indices often yields a wide range of results; therefore a researcher limiting himself to any single index will always be in doubt whether his results do not yield a one-sided, or even distorted picture of industrial location. (This is especially true of areas or centers with differences in the structure of industry or in the level of technology and labor productivity. As an example of differences that arose through the use of different indices, it was stated that the standard metropolitan area of Fall River-New Bedford, which in 1939 had 8 per cent more persons employed in manufacturing than the metropolitan area of Kansas City, at the same time yielded only half as much value added by manufacturing.)

These circumstances led some researchers to try to develop combined criteria, including several statistical indices. McCarty used several indices in delimiting the manufacturing belt; he used as his basis: (a) counties in which industrial workers outnumbered farmers; (b) counties where total industrial output or per capita industrial output exceeded the United States average and (c) counties where the ratio of manufacturing to wholesale trade exceeded the national average (The Geographic Basis of American Economic Life, New York, 1940, pp. 476-504). McCarty computed and mapped each of these indices separately, and then superthe maps one on the other and generalized the boundaries of the manufacturing belt.

In 1955 John H. Thompson ("A New Method for Measuring Manufacturing," Annals of the Association of American Geographers, 1955, Vol. 45, p.416) proposed combined indices of the volume and intensity of industrial production taking into account: (1) the number of employes, (2) the value added, and (3) salaries and wages.

He assumed that all three basic indices were of equal importance and assigned them equal weights. As his base data Thompson took the rounded average magnitudes of the basic indices of 50 standard metropolitan areas as of 1939 (70,000 persons employed in manufacturing; $100,000,000 in salaries and wages, and $200,000,000 in value added), taking each average magnitude as 100. He calculated the relative index of volume of manufacturing by the formula $M = \frac{M_1 + M_2 + M_3}{3}$, where M_1, M_2 and M_3 were the particular relative indices of manufacturing for each of the three stated factors. The relative manufacturing index based on the number of persons employed (M_1) can be obtained for any area or center by the formula

$$M_1 = \frac{\text{number of persons employed}}{70{,}000} \times 100$$

Similarly the relative index based on wages and salaries (M_2) can be obtained by the formula

$$M_2 = \frac{\text{wages and salaries of persons employed}}{100{,}000{,}000} \times 100$$

and the relative manufacturing index based on value added (M_3) is equal for any given area to:

$$M_3 = \frac{\text{value added in the given area}}{200{,}000{,}000} \times 100$$

In cases where the data did not refer to 1939, additional coefficients were introduced into the formulas for M_2 and M_3 to take account of changes in the value of the dollar. For the "yardstick" area with the above-mentioned average magnitudes of the three basic indices, the relative combined index of volume of manufacturing was also taken as 100. For the Boston standard metropolitan area, according to Thompson, the combined volume index was 269 in 1939 and 391 in 1947.

In order to obtain a relative combined index of intensity of manufacturing, Thompson computed the following ratios: (1) the total number of persons employed in manufacturing to the total number employed in the area; (2) the total number of persons employed in manufacturing to the total population of the area, and (3) the value added by manufacturing per capita. He then compared these magnitudes with the corresponding average values for the 50 standard metropolitan areas taken as 100. Subsequent calculations followed the previous pattern, and the relative combined index of intensity

of manufacturing was obtained by the formula

$$I_t = \frac{I_1+I_2+I_3}{3},$$

where I designates intensity .

Thompson asserts that the criteria he has proposed are universal in character and that their use makes possible comparisons of volumes and intensities of manufacturing in any area irrespective of its size. In his article he includes a table showing both indices for the 53 industrially leading standard metropolitan areas in 1939 and 1947 and, on the basis of these indices, calculates the amount of growth of manufacturing within those areas during the stated period.

It seems to us that the two indices proposed by Thompson are of a formal statistical character and have been derived purely subjectively. Their computation requires a great deal of work and the results obtained are hardly more reliable than those obtained through the use of a few individual indices. In comparing data for various years, and also in working with data for individual years (except the year for which the base data have been chosen, additional coefficients must be introduced into the formulas to take account of changes in the value of the currency. However prices of different goods change in different ways and we do not know, therefore, which value of the coefficient is to be regarded as correct. Thompson himself used two parallel coefficients for 1947 (in one case the change in the general wholesale price index, and in the other the average change of prices of the products of each of 20 major groups of manufacturing industries listed in the standard classification of industries) and obtained two significantly different series of figures.

The Bureau of the Census has published studies at various times containing statistical analyses of changes in industrial location in the United States (in particular, Tracy D. Thompson, Location of Manufacturing, 1899-1929, Washington, 1933, and Changes in Distribution of Manufacturing Wage-Earners, 1899-1939, Washington, 1942). These changes have also been analyzed by geographers, but there have been few published studies (H. H. McCarty, Industrial Migration in the United States,1914-27, 1930, and A. J. Wright, "Recent Changes in the Concentration of Manufacturing," Annals of the Association of American Geographers, 1945, Vol. 35, p. 144). Changes that have taken place in industrial location during the Second World War and especially during the post-war period have been investigated to a lesser extent thus far in the American geographical literature.

Some studies have examined factors that tend to promote the development of industry in less developed areas (for example, Glenn McLaughlin and Stephen Robock, Why Industry Moves South, Washington, 1949), the decentralization of industry (D. Creamer, Is Industry Decentralizing? A Statistical Analysis of Locational Changes in Manufacturing Employment, 1899-1933, Philadelphia, 1935), changes in the specialization of

industrial centers (Allan Rodgers, "Some Aspects of Industrial Diversification in the United States," Economic Geography, Vol. 33, p.16) and other problems. Nearly all these studies use data on the total number of employed or the number of production workers as the basic indicator.

A totally different approach to the problem of delimiting manufacturing areas has been used by Hartshorne (Richard Hartshorne, "A New Map of the Manufacturing Belt of North America," Economic Geography, 1936, No.12, p. 45). He tried to establish in what parts of the United States the development of manufacturing had led to evidence of those distinguishing features that are usually associated with a manufacturing area. Hartshorne concentrated his attention on the circumstance that a large part of the manufacturing industry is ubiquitous (in the sense that the plants of some industries are to be found in virtually every city) and localized in function (in the sense that these plants work only for the local market, serve local demand and do not produce for other areas). The existence of such industry does not lead to a geographical division of labor; cities that contain this type of industry cannot be regarded as industrial simply on that basis; in order to earn the designation of "industrial", they would, in addition to industries serving purely local demand, also need to have industries that work for a market outside the given city.

In order to estimate the number of persons working in industries that produce for an external market, Hartshorne assumed that industries working for the local market normally employed about 10 per cent of the total population and proposed that this number be subtracted from the total number of workers employed in manufacturing in each given city. He designated as industrial all cities in which at least 500 industrial workers were employed in industries working for an external market.

Work in that direction was continued by Chauncy Harris ("A Functional Classification of Cities in the United States," Geographical Review, 1943, Vol. 33, p. 86). He also tried to delimit areas where industry was the principal form of economic activity and, in that connection, he proposed a functional classification of cities. As his basic index of specialization, Harris took the ratio of the number of persons employed in industry to the number of persons employed in wholesale and retail trade.

In subsequent years a number of studies were published in the United States devoted to the economic basis of cities (for example, the series of articles by Richard B. Andrews in Land Economics under the general title "Mechanics of the Urban Economic Base," 1953, Vol. 29, p. 266; 1955, Vol. 31, p. 50, 144, 245 etc., and the studies of Homer Hoyt) and the functional classification of cities (the latest articles reviewing the work on functional classification of cities are those of Howard J. Nelson in Economic Geography -- "A Service Classification of American Cities," 1955, Vol. 31, pp. 189; "Some Characteristics of the Population of Cities in Similar Service Classification," 1957, Vol. 33, p. 95). These studies, as well as those published about the same time by European economic

geographers, worked out such concepts as ubiquitous and concentrated industries, basic and non-basic production, city-forming and non-city-forming production and several other concepts essential for study of geography of the economy and, especially, urban geography (a brief summary of work in this field and its present state is contained in Gunnar Alexandersson, The Industrial Structure of American Cities, Stockholm, 1956).

3. The Study of the Distribution of Individual Industries. A more or less comprehensive description of the distribution of various individual industries, both in the United States and in the world as a whole, can be found in many textbooks and economic-geography monographs written by American authors (for example, J. Russell Smith, M. Ogden Phillips and Thomas R. Smith, Industrial and Commercial Geography, 4th edition, New York, 1953, and Erich W. Zimmermann, World Resources and Industries, New York, 1951). However more serious analyses of the distribution of individual industries have been published only for a few industries, mainly those where locational factors are simplest and most easily adapted to quantitative analysis.

Most of the studies in this field are devoted to the iron and steel industry. As early as 1923 O. W. Freeman published a brief summary of factors determining the location of iron and steel plants ("Two Dozen Causes for the Location of Blast Furnaces and Steel Mills in the United States," Journal of Geography, 1923, Vol. 22, p. 144). Somewhat later a more detailed review of those factors and of the general picture of the distribution of the iron and steel industry was published by Hartshorne (Richard Hartshorne, "Location Factors in the Iron and Steel Industry," Economic Geography, 1928, Vol. 4, p. 241, and "The Iron and Steel Industry of the United States," Journal of Geography, 1923, Vol. 22, p. 144). Starting in 1927 a whole series of studies by various authors began to appear dealing with districts of the iron and steel industry. Especially much work in this field was done by C. Langdon White, who from 1929 to 1956 published more than a dozen articles on the geography of the iron and steel industry, including the Pittsburgh, Youngstown, Wheeling, Cleveland and Birmingham districts, the iron and steel industry of Buffalo, Sparrows Point and Duluth, the development of the industry in the Far West, and a comparative survey of the cost of iron and steel production in the Pittsburgh, Chicago and Birmingham districts (White's articles appeared in Economic Geography, Geographical Review and less well-known university publications. One of his studies appeared as a separate pamphlet -- Is the West Making the Grade in the Steel Industry?, Graduate School of Business, Stanford University, Business Research Series No. 8, Stanford, 1956).

Walter Isard investigated changes in the location factors of the iron and steel industry from the start of the 19th century to the present ("Some Locational Factors in the Iron and Steel Industry Since the Early 19th Century," Journal of Political Economy, 1948, Vol. 56, p. 203) and on that basis tried to predict the future locational pattern of the industry (Walter Isard and William Capron, "The Future Locational Pattern of Iron and Steel Production in the United States," Journal of Political Economy,

1949, Vol. 57, p. 118; also Walter Isard and John Cumberland, "New England as a Possible Location for an Integrated Iron and Steel Works," Economic Geography, 1938, Vol. 14, p. 251). Rodgers proposed "industrial inertia" as a key factor in the location of a modern iron and steel industry in the United States (see his above-mentioned article). American geographers also devoted much attention to the location of the iron and steel industry in other countries (John E. Brush in India, Robert Long in Brazil, Allan Rodgers in Manchuria, Clifford Zierer in Australia, and Muzaffer Erselcuk in Japan).

In second place in the number of studies is the textile industry, which, in particular, has been the subject of four doctoral dissertations. One dissertation was devoted to the geography of the aircraft industry (W. Glenn Cunningham, The Aircraft Industry: a Study in Industrial Location, Los Angeles, 1951). Individual studies, often covering only a certain district, have also been devoted to the aluminum, paper, garment, glass, flour and cement industries.

4. Study of Individual Industrial Districts and Centers. Most of the work done in the United States on the geography of industry is devoted to individual districts and cities. The above-mentioned bibliography of industrial geography (up to 1952) contains at least a hundred such items; since then many additional studies have been published. A survey of the principal trends of research on individual districts in various periods (including information on the more interesting studies) was written by Chauncy Harris in his chapter on the manufacturing industry in American Geography (Since this book has been translated into Russian, we will not repeat the substance of Harris' article.)

In recent years several studies (chiefly dissertations) have been published dealing with research on small areas, usually parts of larger urban districts. The center of this work is the University of Chicago and therefore evidently many of the studies cover parts of the Chicago metropolitan area or near-by smaller cities.

5. The Influence of Technological Progress and the Appearance of New Production Processes and Products on the Geography of Industry. This is a relatively new field of research in which American geographers have been making only the first steps.

Some studies devoted to certain industrial districts or industries incidentally investigate the significance of the development of new production processes, for example, the effect of the introduction of man-made fibers on the geography of the textile industry or the effect of the development of petrochemicals on the growth of that industry on the Gulf of Mexico in Texas and Louisiana (see James J. Parsons, "Recent Industrial Development in the Gulf South," Geographical Review, 1950, Vol. 40, p. 67).

Several articles and books have appeared in recent years in which the

possible effect of the use of atomic energy on the structure and location of industry is discussed (see the series of articles by Isard and associates, the monograph by Schurr and Marschak on Economic Aspects of Atomic Energy, and others). However these studies have usually been published by economists rather than geographers (an exception is Stephen B. Jones, "The Economic Geography of Atomic Energy," Economic Geography, 1951, Vol. 27, p. 268).

Another pioneering effort is a recent study of the effect of the rapid growth of automation on industrial location in the United States (D. S. Osborn, The Geographical Features of the Automatization of Industry, Chicago, 1956).

Alone these early studies demonstrate the potentialities for economic-geographic analysis in this interesting field.

RAILROAD FREIGHT TRAFFIC OF THE USSR

By I. V. Nikol'skiy

(Excerpted from I. V. Nikol'skiy, Geografiya transporta SSSR, Moscow, 1960)

(Abstract: Nikol'skiy's book on the geography of transportation of the USSR contains the most detailed freight-flow maps published by the Soviet Union since the 1930's. These maps are reproduced here with appropriate textual excerpts.)

Section 45. The growth of freight traffic in the USSR and its regional distribution (p. 152).

The growth of the Soviet economy has resulted in a sharp increase in railroad freight traffic (Table 21).

Table 21

Railroad Freight Traffic of USSR

Years	Billion ton-kilometers	Million tons
1913	65.7	132.4
1940	415.0	592.6
1958	1302.0	1616.9

(From Narodnoye khozyaystvo SSSR v 1958 godu (The National Economy of the USSR in 1958), statistical yearbook, Moscow, 1959)

Seven basic types of goods account for more than 80 per cent of all railroad traffic. The structure of that traffic in 1958 in ton-kilometers was as follows: coal and coke - 26.8 per cent, wood - 13.7, oil - 11.8, building materials - 8.7, iron and steel (including scrap) - 7, grain - 6.2, ores (including iron pyrites) - 4.6, others 21.2 per cent.

Substantial shifts in the geographical distribution of productive forces have taken place in the process of Socialist development of the national economy; the Urals and the areas east of the Volga account for a larger share of the output, and new centers of heavy industry have arisen. All this changed the geography of freight traffic.

The territory of the RSFSR (within the boundaries of September 17, 1939) accounted for 50.4 per cent of all rail freight loadings on common carriers in 1913, and the Ukraine 42 per cent. As other regions expanded economically, the Ukraine's share in rail loadings dropped to 33.8 per cent in 1940 and 27.5 per cent in 1956. At the same time the share of the RSFSR rose to 59.9 per cent.

Among the major economic regions of the Soviet Union the South holds first place as to outgoing and incoming rail shipments. The pre-eminent position of the South resulted from the establishment of the first coal-and-steel base and the further development of agriculture there. Outgoing freight traffic exceeds incoming traffic in the South. The predominant commodities, in keeping with the character of the regional economy, are coal and coke (39 per cent), iron and manganese ores (12 per cent), iron and steel (8 per cent) and grain (3 per cent). The Center is the second most important major economic region in terms of total outgoing and incoming freight traffic. In connection with the growth of heavy industry of the Urals, the Center has begun to lag behind the Urals in terms of outgoing freight and is keeping its lead in incoming shipments. There has been a sharp increase in outgoing freight in Western Siberia, which is now fourth after the South, the Urals and the Center. The economically most highly developed regions, such as the South, the Center, the Urals and Western Siberia, thus also account for the largest freight traffic.

Rapid economic development of the eastern regions, especially after the Second World War, is reflected in a significant growth of freight traffic. The Urals, Siberia, the Far East, Kazakhstan and Central Asia account for 9.3 per cent of all rail loadings in 1913, and for more than 36 per cent in 1955. The increase was especially marked in the Urals, Western Siberia and Kazakhstan. The percentage share of Kazakhstan in rail loadings rose from 0.5 per cent in 1913 to 4.9 per cent in 1956.

The share of the eastern regions in railroad freight traffic is continuing to increase in the current seven-year plan in connection with expansion of the economy in those regions and the construction of new railroads.

46. Freight traffic density and the principal railroads of the USSR(p.155).

The expansion of the productive forces of the Soviet Union has led to a major increase in railroad traffic. Average freight traffic density per year increased from 1.1 million ton-kilometers per kilometer of operated line in 1913 to 10.7 million ton-kilometers in 1958. No other country has such a high freight-flow intensity.

The average freight-traffic density per year in thousand ton-kilometers per kilometer of operated line in foreign countries was as follows in 1955: Britain - 1131, France - 1173, West Germany - 1593, Italy - 1070, United States - 2561, Turkey - 513, Finland - 915, Japan - 2045 (Zarubezhnyy transport (Transportation Abroad), Vol. 1, Moscow, 1956, pp. 50-51).

The Soviet railroad net carries an uneven load. About 46 per cent of the Soviet railroads carry 86 per cent of the freight traffic, and more than half of the lines account for only 14 per cent of the traffic (V. I. Petrov, Voprosy razvitiya seti zheleznykh dorog (Problems of Expansion of the Railroad Net), Moscow, 1957). While the average freight-traffic density on Soviet railroads in 1953 was 6.7 million ton-kilometers per kilometer of operated line, the freight-flow density varied considerably on individual lines. It was distributed as follows:

Freight-traffic density in million ton-kilometers per kilometer	Percentage of total Soviet railroad net
less than 1	25
1 - 3	18
3 - 10	34
more than 10	23

(From Petrov, op. cit.)

The highest freight-traffic densities occur on rebuilt railroads, especially those joining the Kuznetsk Basin with the Urals, and the Donets Basin with the Center and the Dnieper valley. The new railroads (according to V. I. Petrov's calculations) had freight-traffic densities of less than 5 million ton-kilometers per kilometer on about 80 per cent of their total length, and densities of less than 500,000 ton-kilometers per kilometer on about 25 per cent of their total length (mainly lines of local importance) (Fig. 23).

Some of the new railroads are being used intensively. They include the lines Novokuznetsk-Inskaya-Ob', Karaganda-Akmolinsk-Magnitogorsk, Troitsk-Kartaly-Orsk, Kotel'nich-Gor'kiy, Akmolinsk-Petropavlovsk and the Turkestan-Siberia railroad.

The highest freight-flow intensity in the Soviet Union is found on the Ob'-Omsk section of the Trans-Siberian railroad. That section carries heavy freight flows from the Kuznetsk Basin, from Siberia, and to Siberia. The South Siberian railroad, built to provide an additional outlet for the

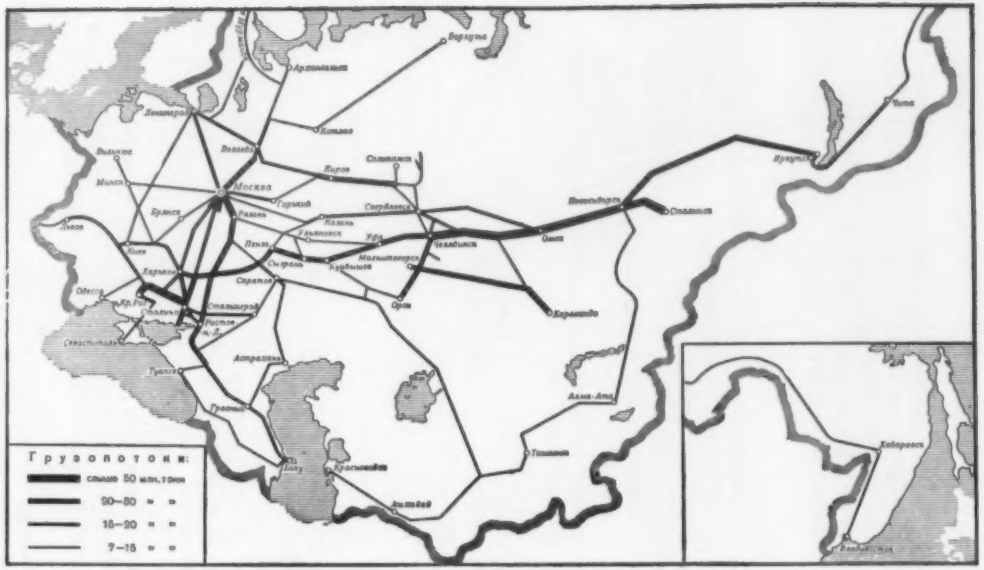


Fig. 23. Freight-flow density on the railroads (after V. I. Petrov)

(Legend:) Freight flows: more than 50 million tons
20-50 million tons
15-20 million tons
7-15 million tons

Kuzbas, does not yet carry any heavy freight traffic on its Altayskaya (Barnaul)-Sorokovaya (Akmolinsk) section because the principal freight movements from Siberia are directed toward Chelyabinsk and Sverdlovsk. The high traffic density on the western part of the Trans-Siberian is explained by the fact that it links the Kuzbas with the middle Urals and the Volga, serves large intermediate industrial centers, such as Omsk, Petropavlovsk, Kurgan and Chelyabinsk, and by the fact that it passes through Siberia's principal grain and livestock district, collecting agricultural products and delivering manufactured goods to collective and state farms. The Kuzbas has only two westward outlets (through Inskaya near Novosibirsk and through Altayskaya near Barnaul), while the Donets Basin, which is a more important coal and steel producer than the Kuzbas, has several outlets. For that reason the multiple Donbas outlets do not carry such a high traffic density as the two Kuzbas outlets.

In the western regions of the USSR, especially in the Baltic republics, a relatively dense railroad net has been formed, with 37.8 km. of line per 1000 sq. km., while the average densities are 34.4 in the Ukraine, 21.3 in the Center and 12.1 in the Urals. On the other hand the western regions have no production centers of the same magnitude as the Ukraine or middle Siberia that would form heavy freight flows. The average freight-flow density in the west is therefore quite low. In 1955 the average density on the Omsk Railroad (a section of the Trans-Siberian) was 26 million ton-kilometers per kilometer of line, while the density on the Baltic Railroad was 1.6 million t-km/km. Many lines in the west have a traffic load of less than 300,000 t-km/km. Some local lines even have loads of less than 100,000 t-km/km, for example, Dukshtas-Voropayevo 39,000, Ust'- Luga-Kotly 27,000, Zhitkovo-Vyborg 34,000.

The aim of transforming Russia's railroad net and creating a "basic transportation grid" was formulated as early as the GOELRO plan (for the electrification of Russia in the early 1920's). The reconstruction of the net and the building of new lines were designed to assure the main inter-regional links within the country.

Transportation links between the Center and the Donets Basin are assured by three principal lines: (1) Moscow-Ryazhsk-Voronezh-Liski; (2) Moscow-Yelets-Valuyki; (3) Moscow-Kursk-Khar'kov-Nikitovka. On all three lines northbound freight exceeds southbound traffic. The heaviest flow of Donbas coal is concentrated on the Valuyki-Moscow line, the shortest route from the Donbas to the Center. All three lines also handle connections between the Center and the Northern Caucasus and Transcaucasia, mainly through Rostov-on- Don. The Moscow-Khar'kov line also carries passengers to the resorts of the Crimea and the Caucasus. Of the three main lines linking the South with the Center, the heaviest traffic density is found on the line Likhaya-Liski-Voronezh-Moscow. South of Gornaya Junction (south of Likhaya), southbound traffic predominates in the direction of Rostov, Armavir, Prokhladnaya . All three lines carry southbound wood shipments to the Ukraine and the Caucasus.

Links between the Center and the Urals and Siberia are assured by four main lines: (1) Moscow-Ryazan'-Ruzayevka-Syzran'-Kuybyshev-Ufa-Chelyabinsk-Omsk-Novosibirsk-Vladivostok, the shortest route from Moscow to the large industrial centers of the middle Volga, the southern Urals, Siberia and the Far East; (2) Moscow-Kazan'-Sverdlovsk, the shortest route between the middle Urals and the Center; (3) Moscow-Gor'kiy-Kotel'nich-Kirov-Perm'-Sverdlovsk, connecting the industrial districts of Moscow, Vladimir, Gor'kiy and Kirov oblasts with the northern and middle Urals and Siberia; (4) Moscow-Yaroslavl'-Buy-Kotel'nich, an important link between the Center and the North and the Urals. Westbound traffic predominates on all these lines. The Moscow-Danilov-Buy-Kirov-Sverdlovsk line carries the principal passenger traffic to the Urals and Siberia. The heaviest freight flows on that line occur in the Danilov-Moscow section, which receives the heavy flow of predominantly wood shipments from the European North along the Arkhangel'sk-Moscow line. Wood shipments also predominate in freight flows from Kirov to Moscow along two routes: through Buy-Danilov and through Gor'kiy-Kovrov.

Links between the Center and the Volga, Kazakhstan and Central Asia are maintained by the following lines: (1) Moscow-Ruzayevka-Inza-Syzran'-Kinel'-Orenburg; (2) Moscow-Michurinsk-Saratov-Ural'sk; (3) Moscow-Gryazi-Povorino-Stalingrad. On the first two lines there is a predominant freight flow toward the Center. On the third line, in the vicinity of Povorino, Stalingrad-bound shipments predominate as part of the heavy flow of wood shipments from the Volga to the Donbas along the route Agryz-Zelenyy Dol-Ruzayevka is diverted at Povorino toward Stalingrad. In the future, connections between Central Asia and the central regions may be improved with construction of the Kungrad-Makat-Aleksandrov-Gay line. Following construction of the Lanchow-Aktogay railroad, the Center and Kazakhstan will be linked with west and central China by the shorter route Moscow-Saratov-Orenburg-Alma-Ata-Urumchi-Yumen-Lanchow-Chengchow.

The main lines linking Moscow with the ports of the Baltic and with Leningrad are: Moscow-Leningrad, Moscow-Bologoye-Dno-Pskov-Tallinn, Moscow-Velikiye Luki-Riga, with branches to Ventspils, Liepaja and Kaliningrad. Westbound shipments from the Center to the Baltic ports predominate. The Moscow-Leningrad line has the highest traffic density among the lines linking Moscow with the northwest. However, even heavier traffic densities are registered on the line from the Pechora coal basin to Leningrad; as it approaches Leningrad the freight flow is increased by traffic from the Urals (joining at Vologda) and from Murmansk (joining at Volkhovstroy).

Moscow is linked with Poland, Czechoslovakia, Hungary, Rumania and the Black Sea ports by the lines Moscow-Smolensk-Minsk-Brest and Moscow-Bryansk-Bakhmach-Kiev. At Bakhmach and Kiev other lines diverge toward the southwest frontier and the Black Sea ports of Odessa, Nikolayev and Kherson.

The Donets Basin is linked with the Dnieper industrial district by the

well-equipped double-tracked Yasinovataya-Sinel'nikovo-Dnepropetrovsk-Dolgintsevo line, which carries large amounts of coal and iron and manganese ores. Coal, iron and steel move from the Donets Basin through Likhaya and Stalingrad to the Volga valley, and wood products are shipped in the westbound direction. The heaviest freight flows from the Urals and the Volga to the Donets Basin move from Chelyabinsk through Syzran' along the Balashov route (Penza-Balashov-Liski-Valuyki). Links between the Donbas and the Caucasus are maintained through Ilovayskaya and Rostov, with the more important freight flows moving through Rostov and Armavir. The principal connections between the Donbas and the Northwest are maintained by the following two lines: (1) Krasnyy Liman-L'gov-Bryansk-Vyaz'ma-Rzhev-Likhoslavl'-Leningrad, and (2) Krasnyy Liman-Vorozhba-Orsha-Vitebsk-Leningrad. The main line linking the Center with the Crimea goes from Khar'kov south through Lozovaya-Sinel'nikovo and Dzhankoy.

The Far East and Siberia are linked with the Urals and European Russia by the following lines: (1) the Trans-Siberian via Vladivostok-Irkutsk-Chelyabinsk; (2) the South Siberian via Stalinsk-Akmolinsk-Magnitogorsk, and (3) the line Omsk-Tyumen'-Sverdlovsk. In addition westbound Siberian traffic has another outlet at Kurgan (on the Trans-Siberian)through Sinarskaya to Sverdlovsk. Westbound traffic predominates in Western Siberia and Northern Kazakhstan, eastbound in Eastern Siberia.

Links between Central Asia and Kazakhstan and Siberia are maintained along two routes: (1) the Turkestan-Siberia railroad via Arys'-Alma-Ata-Semipalatinsk and (2) the Trans-Kazakhstan railroad via Chu-Mointy-Akmolinsk-Petropavlovsk. The Tashkent-Orenburg line links Central Asia and Kazakhstan with European Russia and the Urals.

47. The geography of freight flows of the principal commodities (p. 161). Coal takes first place in railroad freight traffic, both in tons and in ton-kilometers. In 1957 coal accounted for 29 per cent of the freight tonnage loaded and 27 per cent of the traffic in ton-kilometers. From 1913 to 1957 coal traffic increased by 25 times (from 13 to 322 billion ton-kilometers) and the tonnage loaded by 16 times (from 26 to 433 million tons). Coal (anthracite, bituminous and brown coals) makes up 75 per cent of all the fuels carried on Soviet railroads (Table 22).

Table 22
Structure of fuel loadings on Soviet railroads
(in per cent)

Fuel	1913	1940	1950	1957
Coal	64.1	69.8	76.4	75.0
Oil and oil products	13.9	14.2	13.0	17.2
Peat	1.0	4.9	4.0	3.9
Fuelwood	21.0	11.1	5.6	2.9
Oil Shale	-	-	1.0	1.0

(Source: L. Z. Kats, Perevozki uglya po zheleznym dorogam (Coal Traffic on the Railroads), Moscow, 1959, p. 114.)

The principal coal-mining districts, serving not only their own economic region but other regions, are the Donets, Kuznetsk, Karaganda and Pechora districts.

The changes that have taken place in the geography of coal mining under the Soviet regime have greatly changed the pattern of railroad coal traffic. The development of new coal districts and the promotion of small coal mines for local needs have greatly reduced the relative importance of the Donets Basin in total coal production (from 87 per cent of the total output in 1913 to 36 per cent in 1955). Locally mined coal now meets a large part of the coal requirements of the Center, the Urals, Eastern Siberia, the Far East, Kazakhstan, Central Asia and Transcaucasia.

The average length of haul of local coals in 1955 was 310 km. while Donets, Karaganda and Pechora coals were hauled 900 km. on the average (L. Z. Kats, "Problems of Rationalization of Coal Traffic on the Railroads," Voprosy ratsionalizatsii perevozok vazhneyshikh gruzov, (Problems of Rationalization of Hauls of the Principal Commodities), volume of articles, Moscow, 1957, p.45).

Despite the development of new coal basins and the growth of local coal mining, the average length of coal hauls continues to grow. In 1913 it was 485 km., in 1940 - 701, in 1950 - 670, and in 1958 - 729 km. The relative importance of very long hauls has also increased in recent years (Table 23).

Table 23

Distribution of Railroad Coal Hauls by Distance Zones
(in per cent)

Distance (in kilometers)	1950		1957	
	in tons	in t-km	in tons	in t-km
less than 200	33.1	3.5	33.5	3.6
200-600	27.5	15.0	27.0	13.6
600-1000	11.9	14.0	9.6	10.0
1000-2000	19.1	40.5	18.6	37.2
more than 2000	8.4	27.0	11.3	35.6

(Source: Kats, Perevozki..., p. 55)

The growth of long coal hauls is caused by the fact that the coal-mining industry of European Russia is lagging behind the growing demand. This requires the haul of Kuznetsk and Karaganda coals to the Volga valley and the Center over a distance of 3,500 km. In 1950 shipments to these regions from the Kuzbas amounted to 0.7 million tons of coal and from Karaganda 1.6 million tons; in 1955 these coal hauls were 7.4 million and 3.2 million tons, respectively (Kats, "Problems...," pp.46-47).

According to estimates of the Institute of Complex Transportation Problems of the Academy of Sciences USSR it would be far more economical to supply the Volga valley with Donets coal.

The Donets Basin ships more than 60 per cent of its coal to the Ukraine and Moldavia. About one-fifth goes to the Center. In addition Donets coal is shipped to the Northern Caucasus, the Volga valley, Belorussia, the Baltic region, the Northwest and Transcaucasia. The heaviest coal flows are formed in the Donbas and on the lines leading to the Dnieper valley. Yasinovataya is the Soviet Union's largest coal-distributing station, handling more than 42 million tons of coal in 1955. Through Yasinovataya goes a heavy flow of coal traffic along the line Debal'tsevo-Krinichnaya-Yasinovataya-Sinel'nikovo-Nizhnedneprovsk.

Heavy coal traffic moves from Debal'tsevo through Nikitovka and Krasnyy Liman to Khar'kov. In addition to supplying the first coal-and-steel base (in the Donbas and the Dnieper valley) and the Ukraine as a whole, major coal flows go to the central regions and to Moscow through Valuyki, through Liski-Voronezh, and through Khar'kov-Kursk. Donets coal moves to Leningrad via Bryansk-Vyaz'ma (Fig. 24).

Coal of the Kuznetsk Basin is consumed mainly in Western Siberia and in the Urals, and also to some extent in the Volga valley, the Center, Kazakhstan and Central Asia. The main flow of Kuznetsk coal is formed in the Kuznetsk Basin along the line Osinniki-Artyshta-Proyektnaya-Inskaya and joins the Trans-Siberian railroad at Ob', where it merges with the traffic flow from the northern part of the Kuznetsk Basin and with traffic from the Cheremkhovo and Minusinsk coal basins, which ship part of their output to Western Siberia. From Ob' station, the combined flow of coal shipments moves westward to Omsk, where it splits into two branches, the lesser going through Tyumen' and Bogdanovichi and the greater to Chelyabinsk. At Kurgan part of the flow branches off to Sverdlovsk. Westward from Chelyabinsk, part of the coal flow decreases gradually in volume as it moves through Dema-Kinel'-Syzran'. Other parts move northward and southward from Chelyabinsk.

Most of the Karaganda coal is shipped to the Urals; lesser amounts go to the Volga valley, southern Kazakhstan and Central Asia. The main flow routes to the Urals are Akmolinsk-Kartaly and Petropavlovsk-Kurgan-Sverdlovsk. To southern Kazakhstan and Central Asia, Karaganda coal moves via Mointy-Chu.

The marketing zone of Pechora coal is the European North and the Northwest; part of the coal is also shipped to Kirov and Gor'kiy oblasts.

The Cheremkhovo coal basin is the largest coal basin east of the Kuzbas. It ships its output westward to Novosibirsk, Omsk and Semipalatinsk, and eastward to Khabarovsk, mainly for use as railroad fuel.

An important factor in the rationalization of coal traffic is the further growth of waterway hauls and wider use of combined rail-water shipments.

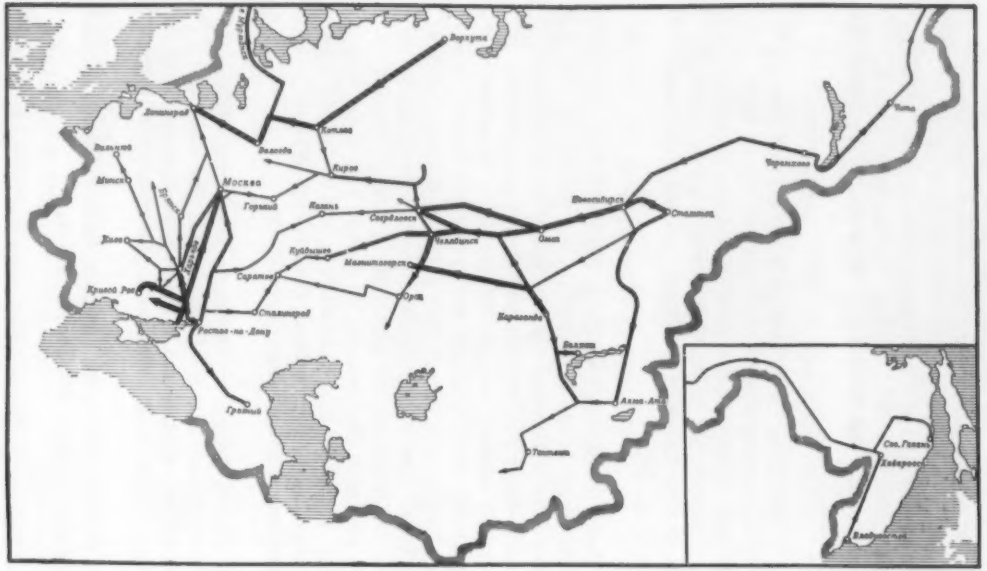


Fig. 24. Principal coal traffic flows on the railroads
(Thickness of lines proportional to traffic volume)

In 1955 only 3.8 per cent of the total coal traffic on railroads and waterways followed combined rail-water routes (Kats, "Problems..."). A rather important transshipping point from railroad to waterway is Nizhnedneprovsk on the Dnieper River. Transshipping points on the Volga are being used to a very slight extent;a great deal of coal is being shipped to markets by railroads paralleling the Volga. (A major obstacle to the expansion of combined rail-water hauls is the fact that many large riverside industries lack coal river terminals; another factor is the slower delivery of coal shipped by combined rail-water routes.) It has been estimated that transport savings involved in delivering coal to Volga industrial centers by combined rail-water routes are 3 to 13 (old) rubles per ton compared with all-rail hauls.

The planned construction of Ust'-Donetskiy port (on the Don River at the mouth of the Donets) and improved shipping conditions on the lower Don will provide a direct waterway outlet for Donets coal to the Volga River and cut transportation costs by 25 to 30 per cent (A. A. Mitaishvili, Vnutrennyy vodnyy transport SSSR i puti povysheniya yego ekonomichnosti (Internal Waterway Transportation of the USSR and Ways of Increasing Its Economical Use), Moscow, 1957, p. 136). Expansion of combined rail-river coal hauls would also reduce the average length of haul on railroads.

Donets coal moving along combined rail-water routes could be transshipped either at river terminals of the Volga and Dnieper basins or at Zhdanov for shipment by sea to the Caucasus. Vorkuta coal could be shipped to a greater extent by rail to the Pechora and Northern Dvina Rivers, and thence by water to Nar'yan-Mar, Murmansk and Arkhangel'sk; it could also be hauled by combined rail-water routes as far as Leningrad and the Cherepovets iron and steel plant.

Coal should also be shipped to a greater extent by combined rail-water routes along the rivers of the Ob' basin, the Yenisey, the Angara and the Amur.

Oil Products. Before the Revolution most of Russia's oil (83 per cent) was produced at Baku. (In 1913 Baku produced 7,669,000 metric tons of crude oil while Russia's total output, within the present borders of the USSR, was 10,281,000 tons including 1,047,000 tons in the area of the present Drogobych and Stanislav oblasts, which were not part of the old Russian Empire.) Since World War II oil production has risen sharply in the Volga region and in the Urals. This has resulted in a decrease of the flow of Caucasus oil to the eastern parts of the USSR. At the present time the Volga region and Bashkiria produce 75 per cent of all Soviet oil. The major new oil-producing districts are: Tuymazy, Ishimbay and Shkapovo in Bashkiria, Shugurovo and Bavly in Tataria, Syzran' and Stavropol' in Kuybyshev Oblast and Buguruslan in Orenburg Oblast.

The geography of the oil-refining industry has also changed. Large new refineries are in operation at Ufa, Kuybyshev, Moscow, Gur'yev, Krasnovodsk, Omsk and Khabarovsk.

Table 24

Soviet Oil Loadings and Traffic in 1955
(in per cent of 1940)

Means of transport	Loadings	Traffic
Railroad	263	280
Waterway	125	147
Pipe line	700	363

(Source: B. V. Krich, "Ways of Rationalizing the Transportation of Oil Products," Voprosy ratsionalizatsii perevozok vazhneyshikh gruzov (Problems of Rationalization of the Transportation of the Principal Commodities), volume of articles, Moscow, 1957, p. 73)

The average length of haul of oil products on all means of transport dropped from 994 km. in 1940 to 928 km. in 1955. At the same time the average length of haul of oil products on railroads increased from 1234 km. in 1940 to 1369 km. in 1958. B. V. Krich explains the increase in the average length of haul by railroads "by a general intensive increase of consumption of oil products, especially in the virgin lands; by a considerable increase of long hauls of crude oil to new refineries built near markets; by shortcomings in the present specialization of refineries, under which some refineries process long-haul crude oil while the crude oil of near-by fields is shipped to other regions; a disparity in the distribution of producing areas and of consuming areas of individual types of oil products; by inadequate use of waterways and pipelines in oil transportation; by many irrational hauls of crude oil and refined products caused by poor planning of supplies and transportation" (Krich, "Ways of Rationalizing...," p. 78).

The new distribution of oil production and refining has changed the geography of oil-transport flows.

Before World War II the Northern Caucasus and Transcaucasia were entirely self-sufficient in crude oil. In 1955 more than 40 per cent of all the oil products shipped to the Northern Caucasus arrived by railroad from the Volga-Urals area; the corresponding percentage for Transcaucasia was 18 per cent. Crude oil and high-sulphur fuel oil are shipped from the Volga-Urals to the Caucasus while low-sulphur fuel oil, various kinds of lubricants and special gasolines are shipped from the Caucasus to the Volga-Urals and Siberia. In 1955 the flow of oil products by railroad from the Volga to the Caucasus was five times greater than the cross haul by railroad from the Caucasus to the Volga-Urals (Krich, "Ways of Rationalizing..,"p. 76).

Krich notes that many cross hauls result from poor planning of the location of oil refineries and the disparity between available refining

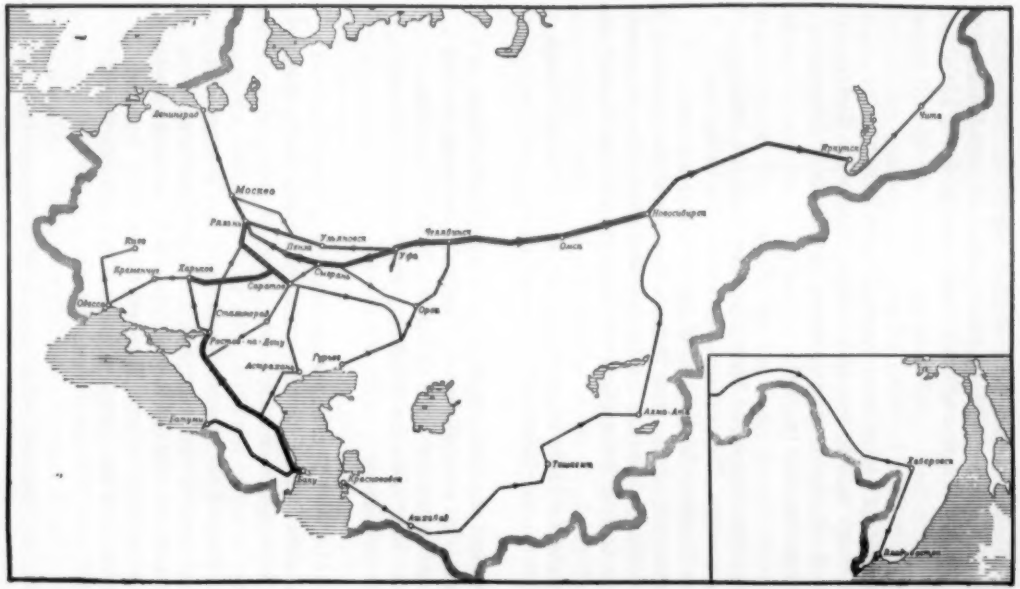


Fig. 25. Principal freight flows of oil products on the railroads
Width of lines proportional to volume of traffic

facilities and the types of refining equipment needed for the crude oil of near-by fields. For example, the Gur'yev refinery, located in the vicinity of the Emba field which produces a crude rich lubricating oil, has no refining facilities for such oils and the Emba crude must be sent to Orsk for refining. The Gur'yev refinery processes crude oil from Tuymazy and from Baku. The nearest refineries to the Stalingrad oil fields are those of Groznyy, but Stalingrad crude is shipped to Orsk for refining. The Saratov oil refinery processes crude from Urussu (a distance of 1040 km.), Klyavlino (900 km.) Buguruslan (624 km.) and Krotovka (524 km.) while crude oil from Sokolovaya Gora, situated 20 km. from the Saratov refinery, is shipped to Orsk, 1100 km. away.

The main flow of Caucasus oil by railroad moves through Rostov to the Donets Basin and, to a lesser extent, through Likhaya-Liski to the Center and Northwest. Some of the Caucasus oil also moves by railroad to Odessa and to Zhmerinka and Pomoshnaya (Fig. 25).

Oil products from the Volga region and Bashkiria move to all the major economic regions of the country. The principal oil flows to the Center are collected along the lines Saratov-Rtishchevo-Michurinsk-Moscow and Syzran'-Ruzayevka-Ryazan'-Moscow; from Ruzayevka some of the oil moves through Arzamas-Murom-Kovrov. At Inza the Syzran'-Ruzayevka flow is joined by another westward flow through Dema-Bugul'ma-Kindyakovka-Inza-Ruzayevka.

From the Volga area and Bashkiria oil traffic to the Ukraine moves through Syzran'-Penza-Rtishchevo-Liski-Valuyki.

The Urals and Siberia are now being supplied to a large extent by the Volga area and Bashkiria. The main oil flow to Siberia moves along the line Tuymazy-Chelyabinsk and on via the Trans-Siberian. Oil from Turkmenia moves to Kazakhstan and Siberia via the Ashkhabad and Tashkent railroads and the Turkestan-Siberia railroad.

The seven-year plan (1959-65) calls for construction of many pipelines that are expected to ease the load on some railroads with a high traffic density; such a pipeline is the Tuymazy-Omsk-Irkutsk line.

Oil transportation on Volga River tankers is now four times cheaper than transportation by railroad and a third cheaper than transportation by pipeline. Nevertheless a large quantity of oil is still being shipped by railroad parallel to the Volga during the navigation season. Many refined products from the refineries on the Volga could be sent by water to the Center, the Northwest, the North and the Urals.

Pipelines have started to play an important role in oil transportation. In 1955 railroads accounted for 46.7 per cent of all crude-oil loadings; pipelines handled 31.1 per cent, river shipping 3.4 per cent and sea-going tankers 13.8 per cent of all oil products. In the seven-year plan pipelines will be called upon to play an increasing role in oil transportation and will thus determine the geography of oil flows.

Iron and manganese ores are shipped in large amounts to the Ukraine, the Center, the Urals, Western Siberia, Kazakhstan and Transcaucasia. A characteristic of this ore traffic is the concentration of loadings and unloadings at a few stations; this is related to a definite localization of mining and of the only consumers of the ore -- the iron and steel industry.

Most of the iron-ore loadings are concentrated in the Ukraine, which in 1955 accounted for 64 per cent of all iron-ore shipments. About 90 per cent of the Krivoy Rog iron ore is shipped to Ukrainian destinations. Most of the traffic out of the Ukraine goes to the Center and West, as well as abroad, mostly through the frontier station of Chop. Most of the loadings of Krivoy Rog ore are concentrated along the section Pyatikhatki-Dolgintsevo. From there part of the ore flow goes northeast through Apostolovo, Zaporozh'ye and Pologi, while another part goes northward through Pyatikhatki and Verkhovtsevo. Verkhovtsevo is one of the Soviet Union's largest ore-sorting stations, originating iron-ore traffic for the iron and steel mills of the Dnieper valley and the Donets Basin. The heaviest ore flow in the Soviet Union moves along the line Pyatikhatki-Verkhovtsevo-Nizhnedneprovsk-Sinel'nikovo-Yasinovataya.

The Urals are second in the loading and unloading of iron ore. More than 83 per cent of the iron ore mined in the Urals is shipped to Urals blast furnaces. The rest is shipped to Western Siberia and other areas of the USSR. Important ore flows move along the lines Sinarskaya-Sverdlovsk-Agryz and Goroblagodatskaya-Sverdlovsk. The development of the Sokolovka-Sarbay iron mines in Kustanay Oblast since 1957 has resulted in the formation of a new ore flow to the Magnitogorsk and Chelyabinsk steel mills.

The main flow of iron ore in the Kuznetsk Basin moves from Tashtagol in the Gornaya Shoriya district to Stalinsk. Iron ore is also moving from the Abakan deposits to the Kuzbas along the new Abakan-Stalinsk railroad. The development in the near future of the Korshunikha iron deposit in the Angara-Ilim district will produce a westward flow of iron ore along the Lena and Trans-Siberian railroads.

New flows of iron ore are also expected to result from the development of the Kursk Magnetic Anomaly, where the Belgorod-Oboyan iron-ore district contains the largest reserves and the highest grades of ore. The best explored deposits of that district, at Yakovlevo and Gostishchevo, north of Belgorod, are situated near the Belgorod-Kursk railroad, on which ore can be shipped both to the Donets Basin and to the Center.

The principal stations loading manganese ore are situated at Chiatura in Transcaucasia and at Chertomlyk and Marganets (near Nikopol') in the Dnieper valley. The bulk of Chiatura ore moves to the port of Poti. Most of the Nikopol' manganese is shipped to the iron and steel mills of the Donets Basin and the Dnieper valley.

In the Urals the main flow of manganese ore moves from Polunochnoye station south through Nadezhdinsk station (Serov) to the iron and steel mills of the Urals. The Urals also receive Dzhezdy manganese from central Kazakhstan.

Iron and steel. The Soviet Union is the leading iron and steel producer of Europe and the second in the world. Its main producing districts are the Ukraine, the Urals, Western Siberia and the Center. These four districts accounted in 1955 for 75 per cent of the total Soviet output of pig iron, steel and rolled products. They also account for most of the railroad traffic in iron and steel, including 86.9 per cent of all iron and steel loadings and 67.2 per cent of all iron and steel receipts.

The principal originating districts in 1955 were the Ukraine, the Urals and Western Siberia, and the principal destinations of iron and steel traffic were the Ukraine, the Urals, the Center and Western Siberia (Table 25).

Table 25

Regional Distribution of Soviet Iron and Steel Production and Traffic in 1955

Region	Production of pig iron, steel and rolled products		Traffic (in per cent)	
	million tons	per cent	outgoing	incoming
USSR	113.9	100.0	100.0	100.0
Ukraine	47.1	33.4	39.1	24.6
Urals	40.8	29.1	31.6	16.8
West Siberia	9.7	6.9	7.4	6.6
Center	6.1	4.4	8.8	19.2
Central Asia and Kazakhstan	0.8	0.6	1.6	4.3
Transcaucasia	1.6	1.1	2.5	2.7
East Siberia	0.7	0.5	1.7	3.3
Far East	0.4	0.3	0.8	1.6

(Sources: Production figures from Promyshlennost' SSSR (The Industry of the USSR), statistical handbook, Moscow, 1957, pp. 112-14; traffic figures from Pomerantsev, "Problems of ..," p. 107)

In 1955 about 52 per cent of all Ukrainian iron and steel shipments terminated within the Ukraine (I. I. Pomerantsev, "Problems of Rationalization of Iron and Steel Traffic," Voprosy ratsionalizatsii perevozok vazhneyshikh gruzov (Problems of Rationalization of the Transportation of the Principal Commodities), volume of articles, Moscow, 1957). The rest of the Ukrainian-originated iron and steel traffic goes mainly to the Center, Belorussia, the Baltic region, the Northern Caucasus, the Volga valley, as well as to the Urals, Siberia, the Far East, Central Asia and Kazakhstan. The heaviest iron and steel traffic goes to Khar'kov, Moscow and the Volga valley.

The Urals consumes 42 per cent of its iron and steel production. The rest is shipped to all regions of the Soviet Union, mainly the Center, the Volga valley, the Caucasus and the Ukraine.

An important flow of iron and steel originates at Magnitogorsk and moves in part to Chelyabinsk and Sverdlovsk and in part to Orsk, Orenburg, Kinel'. In the northern Urals an iron-steel flow originates in Nadezhdinsk station (Serov) and goes in part to Sverdlovsk, increasing in volume en route, and in part to Perm', where it joins a flow of iron and steel from the Kuznetsk Basin westward to Leningrad. From Sverdlovsk iron and steel products are shipped westward through Kazan'.

The Center consumed 52 per cent of its iron and steel output and shipped the rest mainly to the Ukraine, the West, the Northwest, as well as the Urals, Siberia, the Far East and the Caucasus. West Siberia consumed 35 per cent of its iron and steel output, shipping the rest mainly to the Urals and East Siberia.

From Novokuznetsk station (Stalinsk) in the Kuznetsk Basin, iron and steel moves through Yurga eastward as far as the Far East, and through Proyektnaya westward to Sverdlovsk, Chelyabinsk and beyond. There have been irrational cross hauls and repeated hauls of iron and steel because of planning errors (for details, see Pomerantsev, "Problems of...").

Forest Products. About 62 per cent of all the traffic in forest products is by railroad in the Soviet Union. The development of new lumbering areas of the European North, the Urals and Siberia, especially since World War II, has resulted in a substantial increase in the length of haul of forest products. The average length of haul was 415 km. in 1913, 1019 km. in 1940 and 1469 in 1958.

Most of the lumber reserves are found in Siberia and the Far East, which together account for 45.5 million cubic meters, or 75 per cent, of the total standing timber of the Soviet Union. There are also substantial reserves in the European North (4.8 million cubic meters) and in the Urals (3.3 million cubic meters), accounting for 13.5 per cent of the total reserves.

In 1955 wood fellings in lightly forested areas exceeded or virtually equalled the allowable cut. In the Ukraine fellings exceeded the allowable cut by a factor of 2, in Lithuanian by 2.5, and in Belorussia by 1.5. Fellings also exceeded the allowable cut in Latvia and Estonia and virtually equalled it in the Center and the Volga valley. At the same time fellings in the main forested areas amounted only to a small percentage of the allowable cut; 30 per cent in the North, 15 per cent in West Siberia, 6 per cent in East Siberia, and 9 per cent in the Far East. In the future the principal suppliers of forest products should be Karelia, the North, the Urals, and West and East Siberia. The forests of the Far East should meet regional needs and provide export through Pacific ports.

The length of haul of railroad traffic in forest products could be reduced through broader utilization of waterways and combined water-rail hauls, as well as through more rational distribution of the wood-processing industry.

Nearly 60 per cent of all the sawnwood production is concentrated in wood-consuming areas, with 20 per cent alone in the Center. The lumbering districts of Siberia, distant from markets, account for only 10 per cent of the sawnwood. Consequently roundwood accounted in 1940 for 60 per cent of all railroad traffic in forest products; the percentage rose to 72 per cent by 1955, mainly because of an increase of roundwood removals from Siberia (I. V. Tsyplakov, "Rationalization of Traffic in Forest Products," Voprosy ratsionalizatsii perevozok vazhneyshikh gruzov (Problems of Rationalization of the Transportation of the Principal Commodities), volume of articles, Moscow, 1957).

About 45 per cent of all prefabricated homes and parts are manufactured in the Center, the Ukraine, Belorussia and the Baltic region, where manufacturing plants lack an adequate raw-material base. The lumber-surplus districts of the Urals, West and East Siberia produce only 25 per cent of the Soviet Union's prefabricated homes and parts although these districts, as well as the associated regions of Kazakhstan and Central Asia, consume 30 per cent of the total output (Tsyplakov, op. cit.). The Northwest, the Center, the Volga valley and the Urals originate 79 per cent of all railroad shipments of prefabricated homes and parts; 68 per cent of that output is shipped to other regions (Tsyplakov, op. cit.). At the same time these regions receive a large amount of prefabricated homes and parts from other regions.

The heaviest flow of forest products originates on the Northern Railroad. It starts at Arkhangel'sk and moves southward, steadily increasing in volume. In the area of Konosha it is joined by a flow from the Pechora Railroad, and at Danilov by another flow from the Kirov-Buy line. From Danilov this large flow moves to Moscow, and then branches out to Bryansk-Bakhmach, Tula-Khar'kov, Yelets-Valuyki, and Ryazan'-Voronezh-Liski-Likhaya (Fig. 26).

On the Kirov Railroad a flow of forest products starts at Sorokskaya station (Belomorsk) and, gradually growing in volume, moves southward to Volkhovstroy; from there the greater part moves to Mga, and the lesser part to Chudovo. From Mga station, the wood traffic goes to Leningrad, and also branches out along the line Gatchina-Pskov to the Baltic region, and through Dno-Orsha to Belorussia and the Ukraine as far as Odessa.

Forest products originating in the Urals move in part southward from Sverdlovsk through Chelyabinsk-Orsk to western Kazakhstan, and in part westward through Agryz-Kanash, where a smaller branch goes off to Moscow and the greater part continues through Balashov to the Donets Basin.

The principal wood traffic from Siberia is westward along the Trans-Siberia.

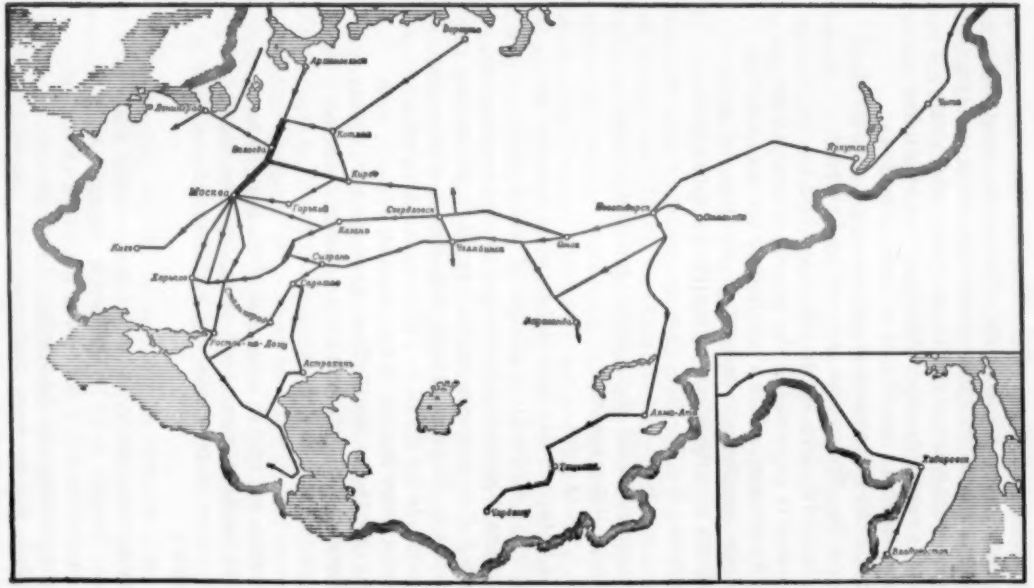


Fig. 26. Principal freight flows of lumber on the railroads

Width of lines proportional to volume of traffic

At Sokur station (near Novosibirsk) most of this traffic branches off to Inskaya and continues on to southern Kazakhstan and Central Asia, while the rest continues to Chelyabinsk, and on through Kinel'-Syzran' to the Center and the South.

Mineral Building Materials. Local mineral building materials, such as gravel, sand, clay, stone, lime ,have a short length of haul because they are usually quarried near consumers. Some types of building materials, such as cement, alabaster, mineral wool, tar paper and other roofing materials, are not always produced near consumers and must often be hauled over long distances. However, since local types of building materials predominate, the average length of haul is relatively short. While loadings of building materials (in tons) account for about one-fifth of all railroad loadings, traffic of these materials (in ton-kilometers) amounts to only 8 per cent of the total railroad freight traffic. The average length of haul of these materials was 253 km. in 1940, 296 km. in 1950 and 352 km. in 1958. The gradual increase is explained by the growing volume of construction in Siberia and Kazakhstan, where a full-fledged building-materials industry did not always arise together with industrial and residential construction projects. Shortages of certain types of materials required their shipment from remote regions.

In 1955 railroads accounted for 88.4 per cent of the total rail and waterway traffic of mineral building materials.

One of the principal industries in this field is the cement industry. Increased demand for cement has resulted in a substantial growth of the Soviet cement industry. Cement production (within the present borders of the USSR) increased from 1.8 million tons in 1913 to 33.3 million tons in 1958, or by a factor of 19. However cement production is still lagging behind demand, and imports into the USSR in 1956 exceeded the total cement output of pre-revolutionary Russia. A few economic regions, such as the Northern Caucasus, the Urals, the Ukraine, Azerbaydzhan, Latvia, Lithuania and Georgia, produced slightly more cement than they needed in 1956.

There is a cement shortage not only in areas east of the Urals, where the volume of construction has been increasing more rapidly than cement output, but also in such regions as the Center and the Volga valley with their large cement industries.

The greater part of the cement industry is located in the central and southern parts of European Russia. In 1956 the Center, Ukraine, Volga valley and Caucasus accounted for 62.5 per cent of the Soviet cement output, the Urals 13 per cent, Siberia and the Far East 11.4 per cent, Kazakhstan and Central Asia 4.5 per cent. According to the Cement Research Institute, regional cement production in 1956 covered regional needs in Kazakhstan by 47.7 per cent, in West Siberia by 79 per cent, in East Siberia by 64.8 per cent and in the Far East by 91 per cent.

The existence of inter-regional cement hauls is explained not only by inadequate distribution and growth of the cement industry in some regions, but also by a disparity in the location of production of individual cement types and various varieties of cement.

Many mills produce a limited range of cements; this is especially true in Kazakhstan, Siberia and the Urals. Puzzolan cement makes up 15.8 per cent of all Soviet production. The Kuvasay and Khilkovo mills of Uzbekistan produce mainly puzzolan cement, which is shipped in large part to other parts of the country while Portland cement is imported into Uzbekistan from the Karaganda mill. Karaganda Oblast exports Portland cement and Portland blast-furnace cement while importing other varieties of cement.

About 40 per cent of all the cement produced in the USSR is of low strength (up to 300 strength). The mills of Siberia, Kazakhstan and Central Asia do not produce enough high-strength cement. This accounts for many cross hauls.

Puzzolan cement is produced chiefly in European Russia, and in part at the Sukhoy Log mill in the Urals, as well as in the Far East and Central Asia. Sulphate-resistant cement is produced at the Novorossiysk, Vol'sk and Serebryakovo (Stalingrad Oblast) mills. Such a distribution of production of these types of cement does not meet the requirements of various regions and leads to cross hauls (A. I. Shekhtman, "Problems of Rationalization of the Transportation of Cement and Raw Materials for the Cement Industry," Voprosy ratsionalizatsii perevozok vazhneyshikh gruzov (Problems of Rationalization of the Transportation of the Principal Commodities), volume of articles, Moscow, 1957). Sulphate-resistant cement moves from the Volga cement mills to Siberia and the Far East while puzzolan cement and Portland cement are shipped in the opposite direction from the Far Eastern mills to Krasnoyarsk.

The construction of new mills after World War II has reduced the average length of haul from 1001 km. in 1940 to 524 km. in 1956. The length of haul could be reduced even further both through rational location and distribution of production by types and varieties and through expansion of waterway transportation. Out of a total of 24,783,000 tons of cement loaded in 1956, railroads handled 77.2 per cent, waterways 3.6 per cent and local means of transport 19.2 per cent.

Grain products are carried on nearly all railroads of the Soviet Union, with the share of railroads in the total rail and water traffic steadily increasing (Table 26).

A great deal of grain is loaded on the railroads of the Ukraine, the Northern Caucasus, the Volga valley, West Siberia and northern Kazakhstan. The principal grain-importing regions are the Central Industrial Region, Belorussia, the Baltic region, the Northwest, the Northeast, Central Asia and the Far East. In connection with the development of the virgin lands,

Table 26

Transportation of Grain Products

Type of transport	1940 million tons	1940 per cent	1950 million tons	1950 per cent	1958 million tons	1958 per cent
Railroads	44.6	87	38.8	89	71.5	90
Rivers	5.2	10	4.6	10	6.9	8
Coastwise	1.5	3	0.5	1	1.4	2

(Source: Narodnoye khozyaystvo SSSR v 1958 godu (The National Economy of the USSR in 1958), statistical yearbook, Moscow, 1959, pp. 549, 562, 564).

grain loadings have increased considerably on the railroads of the southern Urals, Siberia and Kazakhstan, bringing about substantial changes in the geography of grain transportation. In a study of combined rail-water hauls of grain products in the Volga-Kama and Volga-Don basins, A. I. Shein notes the following general shifts in grain transportation:

"(1) A sharp increase of grain flows from the Urals, Siberia and Kazakhstan to European Russia; while about one million tons of grain was hauled from the eastern regions to European Russia in 1940 and in 1950, that flow increased to 6 million tons in 1954 (the first year of virgin-lands cultivation), and doubled again in 1956.

"(2) A certain reduction of grain hauls from the Northern Caucasus and the Lower Volga to the Center and the Upper Volga as the latter regions are increasingly supplied by grain from the east and Northern Caucasus grain is shifted to export abroad.

"(3) An increase of shipments of Northern Caucasus grain to Transcaucasia and a corresponding reduction of shipments from the Black Sea oblasts of the Ukraine to Transcaucasia.

"(4) A cessation of shipments of Northern Caucasus grain to the republics of Central Asia across the Caspian Sea and the growth of a grain flow in the opposite direction from Kazakhstan to Transcaucasia via Krasnovodsk and Baku" (A. I. Shein, "Combined Rail-Water Hauls of Grain Products," Smeshannyye zheleznodorozhno-vodnyye perevozki (Combined Rail-Water Hauls), volume of articles, Moscow, 1958, p. 47).

Grain loadings on the railroads of northern Kazakhstan and West Siberia increased twentyfold in 1953-56. A characteristic feature of grain transportation is its seasonality. During the harvest from August through September 20-22 per cent of the yearly volume of grain is loaded (Ye. N. Vinogradova and S. P. Stychinskiy, "Problems of Rationalization of

Transportation of Grain Products," Voprosy ratsionalizatsii perevozok vazhneyshikh gruzov (Problems of Rationalization of the Transportation of the Principal Commodities), volume of articles, Moscow, 1957, p. 177). Some railroads in the grain-producing districts of the wooded steppe zone carry an especially large amount of grain. Out of the total loadings in 1956, grain accounted for 31.4 per cent on the Omsk Railroad, 28.8 per cent on the Karaganda Railroad (now part of the Kazakh Railroad), 15.6 per cent on the Orenburg Railroad, 13.5 per cent on the South Urals Railroad, 10.5 per cent on the North Caucasus Railroad, 9.3 per cent on the Krasnoyarsk Railroad and 8.4 per cent on the Tomsk Railroad (Vinogradova and Stychinskiy, op. cit., p. 177).

Large grain flows move from the Ukraine, the Northern Caucasus and the Volga valley to the Center, the Northwest and Belorussia. The grain from the southern Urals, West Siberia and northern Kazakhstan is hauled mainly westward as well as to Central Asia. The flow of grain from Siberia and northern Kazakhstan to the central regions of the USSR rose sharply in 1956. The heaviest grain flow now moves on the Trans-Siberian from Novosibirsk to Chelyabinsk.

The geography of grain transportation changes from year to year in accordance with harvests. Uneven distribution of the harvest sometimes produces excessively long grain hauls. The average length of haul has been increasing steadily from 544 km. in 1913 to 736 km. in 1940, 795 km. in 1950, 950 km. in 1955 and 1129 km. in 1958. This increase, especially in the last three years, is explained by the rapid expansion of commercial grain production in Siberia and northern Kazakhstan and the lag of construction of storage facilities in those regions. A large part of the eastern grain must be shipped westward not only for consumption but for storage. The increase in the length of railroad hauls is related also to inadequate use of waterways.

An additional factor is the continuance of irrational hauls. An analysis of present-day inter-regional links shows a large number of irrational hauls, especially excessively long hauls and cross hauls. This is due largely to improper planning of transportation and supplies, errors in the distribution of production of individual crops, a lag in the construction of storage facilities and shortcomings in the location of the milling industry.

Railroad Traffic in the Center (p. 256). The Center consists of the Central Industrial, Central Chernozem and Volga-Vyatka economic regions.

The central location of the region amid the headwaters of the principal streams of the East European plain long ago led to the establishment there of the nucleus of the Russian state and of links with neighboring regions. The growth of the regional economy was promoted by the development of a transport network; natural resources entered into the picture only at a later stage.

A characteristic feature of the Center is a pattern of radial land routes fanning out in all directions from Moscow, which is the country's principal transportation hub and occupies a central position in the Soviet railroad network and in the system of waterways of European Russia.

With a population equal to that of France and an area nearly double that of France, the Center contains internal differences in natural conditions and in economic life. General features of all parts of the Center are an important manufacturing industry, an inadequate fuel and energy base and a shortage or complete lack of many raw materials used by the manufacturing industry. All types of fuels therefore make up a large part of the incoming traffic.

The Center is a region of diversified machine building and instrument manufacturing, requiring skilled labor. Other important activities are the chemical and textile industries, as well as other types of light industry and diversified food processing.

The Center has deposits of brown coal, peat, building materials, chemical raw materials, and large hydroelectric resources and forest areas. The iron-ore deposits of the Kursk Magnetic Anomaly, with a high metal content, large reserves and relatively shallow-depth location, are expected to play an increasing role in the future.

Moscow, as the country's largest city and manufacturing center, requires large supplies of fuel, raw materials and food. Before World War II, the freight traffic of Moscow, the country's leading freight and passenger railroad center, amounted to 50 million tons, of which 38 were incoming and 12 outgoing freight.

Besides Moscow, the Center contains many other large cities with an important manufacturing industry that require supplies of fuel, raw materials and food far exceeding in weight the amount of manufactured goods produced. The Center therefore has a passive traffic balance.

Railroad traffic plays a dominant role in the Center, which is in second-place among the country's transport-economic regions (after the South). However in view of the development of railroad traffic in other regions, the percentage share of the Center in the national railroad traffic is relatively small -- about 17 per cent of the combined loading and unloading operations - and not at all proportional to the region's share of the nation's population or value of industrial output. This is explained by the nature of the regional economy, and consequently by the structure of the railroad traffic. Incoming freight accounts for about 60 per cent of both incoming and outgoing tonnage.

Railroads of the Central Region in 1955 loaded 186.6 million tons of goods and unloaded 242 million tons (Narodnoye khozyaystvo RSFSR (The National Economy of the RSFSR), statistical handbook, Moscow, 1957). The passive traffic balance is typical not only of the Center as a whole but nearly all its oblasts and autonomous republics. Only in the Mari ASSR and

Tula Oblast did loadings exceed unloadings; Tula Oblast loaded 16.7 million tons and unloaded 16.4 million. The active balance in the Mari ASSR is due to large lumber shipments, and in the Tula Oblast to coal shipments from the Moscow Basin.

Coal constitutes the principal freight on the railroads of the Center, accounting for 27 per cent of all unloadings, followed by mineral building materials, wood, grain, iron and steel, and ores, in that order. Peat also plays a substantial role in railroad traffic of the Center. In 1955 more than 10 million tons of peat were loaded. About 60 per cent of the incoming freight originated within the Central Region, 27 per cent in adjoining regions, and 13 per cent in more distant regions. Most of the inter-regional shipments come from the South, the Northwest, the North, Belorussia and the Volga valley.

A characteristic feature of the railroad traffic of the Central Region is the focusing of the principal freight flows on Moscow. The heaviest flows move toward the capital out of the south, east and north, with lesser flows coming out of the west, northwest and southwest. Among the latter directions the heaviest traffic density exists on the Leningrad-Moscow line. Among the railroads entering Moscow, only the Moscow-Rzhev line has a predominance of traffic away from the capital. In the western part of the Central Region, west of the line Bryansk-Vyaz'ma, there is a predominance of westward flows from Rzhev to Velikiye Luki, from Vyaz'ma to Smolensk and Orsha, from Fayansovaya to Roslavl' and Krichev, and from Bryansk to Unecha and Gomel' (Fig. 41).

The largest freight flow moves along the Moscow-Donbas line. It consists mainly of coal. Large freight flows are also formed on the line Liski-Gryazi-Ryazhsk-Ryazan'-Moscow, consisting both of coal and of oil from the Volga valley, coming through Ruzayevka.

Heavy lumber flows tend to swell the traffic density on the lines Danilov-Yaroslavl'-Moscow and Gor'kiy-Kovrov-Moscow. At Danilov the lumber flows merge from the directions of Vologda and Kirov.

A heavy flow of railroad freight, mainly transit goods, moves in the southeastern part of the Central Region along the line connecting the southern Urals and the Volga valley with the Donets Basin, the so-called Balashov route via Valuyki, Liski, Povorino, Rtishchevo, Penza and Syzran'.

The North (p. 271). The transportation region of the North consists of two economic regions -- the Northwest and the Northeast of the European part of the USSR.

An important feature of the geographical location of the North is that it opens on the Baltic, Barents and White seas. Freight traffic in the North is handled by railroad, river and coastwise shipping. The rail net links

the principal ports of the region -- Leningrad, Murmansk and Arkhangel'sk. Murmansk is open all year round. Artificial waterways -- the Volga-Baltic and the White Sea -Baltic -- have improved transportation both within the region and with the Center and Volga valley. A large net of internal waterways plays an important role in assuring links between parts of the North.

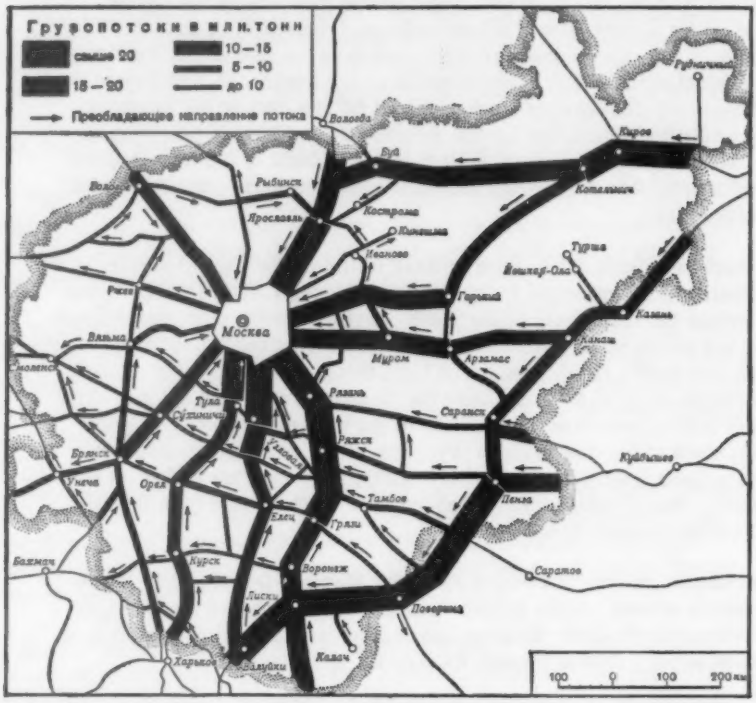


Fig. 41. Freight traffic density on the railroads of the Center (1955)

(Legend:) Freight flows in million tons
more than 20 10-15
15-20 5-10
less than 5
predominant direction of flow

The huge territory of the North, more than 50 per cent larger than the Center, contains substantial differences in population density, degree of economic development and combinations of natural resources and economic specialization. The importance of the North in the national economy is determined mainly by the manufacturing industry of Leningrad, the country's second largest manufacturing center after Moscow. More than half of Leningrad's industrial labor force is employed in the city's machine-building and metal-fabricating industry.

Leningrad is the focus of important freight flows moving from several directions, the largest being the coal flows from the Pechora basin in the northeast.

In view of its maritime location, the North is called upon to function as a major foreign trade outlet of the Soviet Union as well as to insure coastwise shipping connections with the Baltic region, Siberia and the Far East. The development of shipbuilding and fisheries is also a consequence of the regional location.

Other regional industries of national importance are lumbering, wood processing and mining. The location of coal and iron deposits in different parts of the North has determined the choice of the site of the region's iron and steel industry, established at Cherepovets on major rail and water routes near the principal regional markets. The first two blast furnaces are already in operation at Cherepovets. The plant's fuel base, the Pechora basin, is 1900 km. away. Ore for the plant is mined in the Kola Peninsula at the Yena-Kovdor and Olenegorsk deposits, situated 1300 to 1400 km. from Cherepovets. Future mining operations are also envisaged at Kirovogorsk (10 to 12 km. west of Olenegorsk).

Coordination of railroads and waterways and close connections between the Northeast and the Northwest tend to unite the North from the point of view of transportation.

The principal regional freight consists of lumber, coal and building materials. Lumber and coal account for 65 per cent of all railroad freight (outgoing and incoming). Lumber is in first place among railroad loadings. In recent years, expansion of coal mining in the Pechora basin has led to an increase in coal traffic, which is now almost equal to lumber traffic. More than half of all the coal loaded in the Pechora basin is shipped to the Northwest.

The North has an active traffic balance, with loadings somewhat exceeding unloadings. However in the Northwest incoming traffic far exceeds outgoing traffic, largely because of the heavy flow of fuel, raw materials and food to Leningrad with its important manufacturing industry and large population.

In 1955 the North as a whole loaded 79 million tons on railroads and received 76 million tons. Leningrad Oblast accounts for more than half of all freight receipts and 22 per cent of all loadings. Vologda and Pskov oblasts also have a passive traffic balance. About 50 per cent of all railroad loadings in the North is made up by Arkhangel'sk Oblast and Komi ASSR, with lumber dominating in Arkhangel'sk and Pechora coal in the Komi ASSR.

The railroad with the highest traffic density in the North is the line Vorkuta-Kotlas-Konosha-Vologda. The main freight from Vorkuta to Konosha is coal. From Konosha southward a heavy flow of lumber traffic is added. At the same time part of the Pechora coal moves northward along the Konosha-

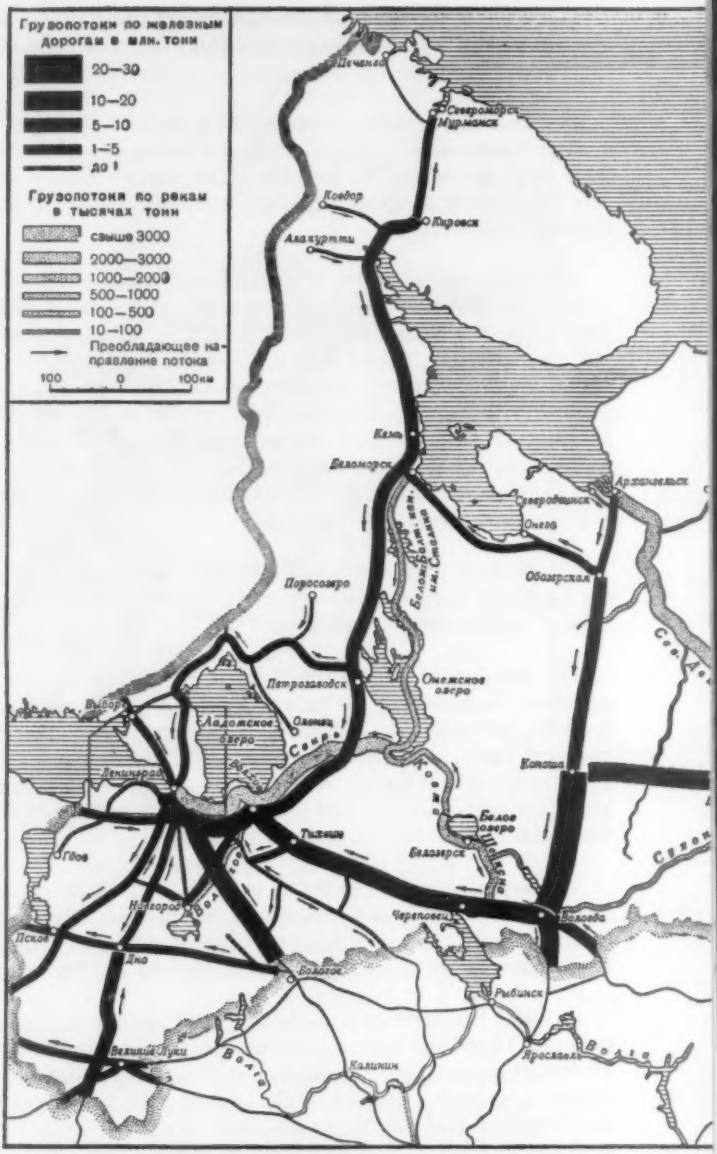
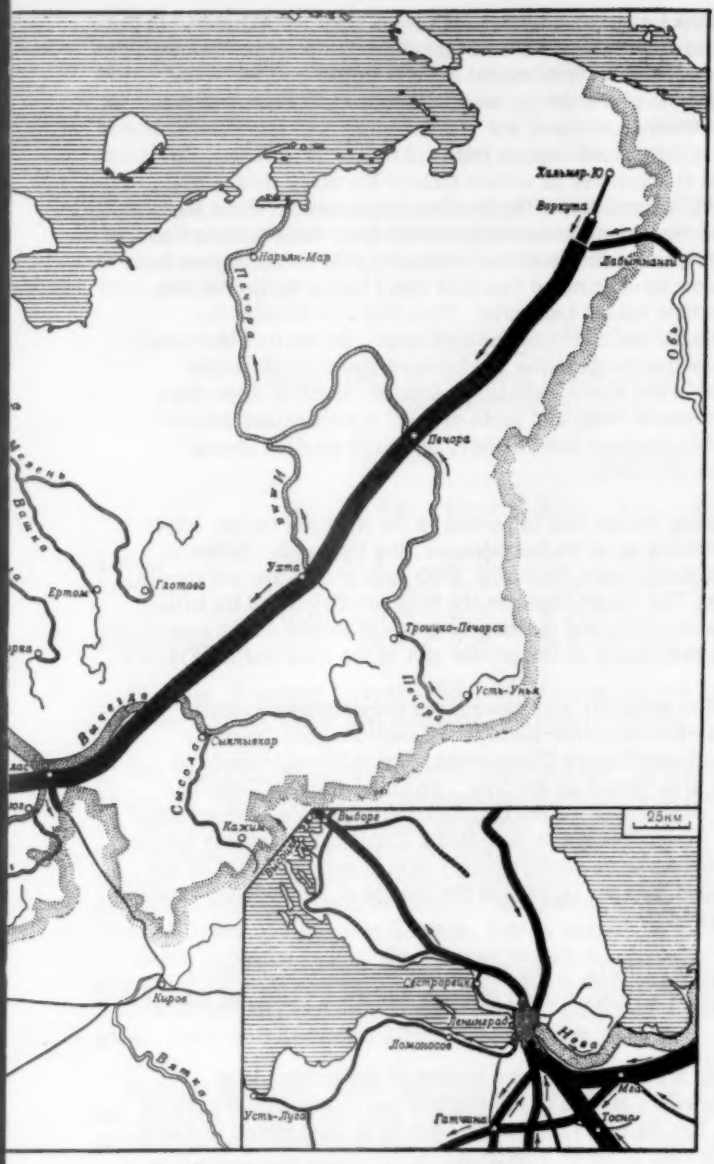


Fig. 44. Freight traffic density on railroads and waterways of the European North (1955)

(Legend:) Freight flows on railroads in million tons

20-30	1-5
10-20	less than 1
5-10	



Freight flows on rivers in thousand tons

more than 3000	500-1000
2000-3000	100-500
1000-2000	10-100

predominant direction of flow

Arkhangel'sk line either for consumption at Arkhangel'sk or, to a greater extent, for shipment to Murmansk via the Obozerskaya-Sorokskaya (Belomorsk) line. The Konosha-Vologda section has the highest traffic density in the North. From Vologda most of the lumber moves southward, and most of the coal moves eastward toward Leningrad via Volkhov and Mga. The Vologda-Leningrad section has the second highest traffic density. The predominant coal flow on this line is increased in volume through the addition of lumber and building materials, especially on the Volkhov-Mga section. From Mga most of the lumber continues on the Gatchina-Pskov line. Nevertheless the Mga-Leningrad section is the line with the heaviest traffic on the approaches to Leningrad. The Moscow-Leningrad line also has a heavy traffic density, with the predominant flow toward Leningrad. This line also handles the largest flow of the diversified traffic out of Leningrad. On the line Murmansk-Petrozavodsk-Volkhov the divide in the predominant direction of freight movements is located in the Kem'-Sorokskaya section. North of Kem' there is a predominant northbound flow, and south of Kem' a predominant southbound flow toward Petrozavodsk and Volkhov, gradually swelled through the addition of lumber shipments.

The largest waterway freight flow is formed on the Northern Dvina, either directly at Dvina terminals or on its headstreams, the Vychegda, Sukhona, Vaga and Pinega. At Kotlas more than 600,000 tons of coal are transferred from railroad to river. The freight flow on the Northern Dvina and its tributaries is generally downstream and reaches its greatest volume on the approaches to Arkhangel'sk. Lumber makes up the greater part of the river traffic (Fig.44).

Lumber and building materials also move along the waterway Vytegra-Novo-Mariinsk Canal-Kovzha River-Belozersk Canal-Sheksna, with the predominant flow southward toward Cherepovets. Freight flows consisting mainly of lumber are also formed on the Svir', Volkhov, Ladoga Canal and Neva River, moving downstream toward Leningrad and reaching their greatest volume on the Neva River. The White Sea-Baltic Canal carries mainly lumber. On the Pechora River shipments consist mainly of coal and lumber, with the coal being transshipped from the railroad at the station of Pechora and moving downstream to Nar'yan-Mar.

The Baltic Region (p. 282). The Baltic Region includes the three union republics of Estonia, Latvia and Lithuania and the Kaliningrad Oblast of the RSFSR.

Links with the sea are a characteristic feature of the Baltic region. The long Baltic coastline offers access to the shortest sea routes from the USSR to Western Europe. The Baltic coast freezes only for a short period in winter, and remains virtually open south of Ventspils.

The development of the transportation net has been affected by the geographical location of the Baltic republics on the western borders of the country and on the routes to the Baltic ports. The region lacks such important mineral resources as coal, oil and ferrous or nonferrous ores. There are

deposits of oil shale, peat, amber, building materials, as well as forestry and agricultural resources and fisheries. A high population density has led to the development of manufacturing, especially machine building and various branches of the lumbering, light and food-processing industries. Incoming freight, consisting mainly of fuel and raw materials for the manufacturing industries, accounts for a passive traffic balance.

Various types of transportation combine in handling freight. Although railroad freight predominates (except for trucking, which is limited largely to short hauls within cities and plants), ocean-going shipping plays a major role in foreign trade (Table 43).

Table 43

Freight Traffic of the Baltic Region in 1955
(in million tons)

	Outbound			Inbound		
	Rail	Sea	River	Rail	Sea	River
Latvia	7.8	1.5	1.0	12.2	0.8	1.0
Lithuania	4.9	0.9	0.3	8.8	0.4	0.3
Estonia	8.0	0.4	0.1	8.0	0.5	0.1
Kaliningrad	3.8	no data	0.8	5.2	no data	0.8

(Source: Transport i svyaz' SSSR (Transportation and Communications of the USSR), statistical handbook, Moscow, 1957).

The Baltic region has a relatively dense rail net, an average of 40 km. of line per 1000 sq. km. A characteristic shortcoming of the rail net is the large number of narrow-gauge railroads, especially in Estonia, where they account for 47 per cent of the total net. This raises the cost of rail transportation because of transshipments, slows direct traffic between some points and requires excessive detours, for example between the cities of Tartu, Viljandi and Pärnu in Estonia. Traffic density on the railroads of the Baltic is generally low. On the most heavily traveled lines it is almost half of the national average. Some lines have a density of less than 300,000 ton-km. per km., and some lines, especially those of narrow gauge, carry even less than 100,000 t-km./km.

Building materials, lumber and chemical goods make up the bulk of the rail loadings. Mineral building materials, coal, oil, iron and steel account for most of the railroad receipts. A great deal of peat is carried by railroad and, in Estonia, oil shale.

The largest railroad center of the Baltic region is Vilna, handling mainly transit freight. The heaviest freight flows arrive from the directions of Minsk-Molodechno and Baranovichi-Lida. The greater part of the outbound traffic

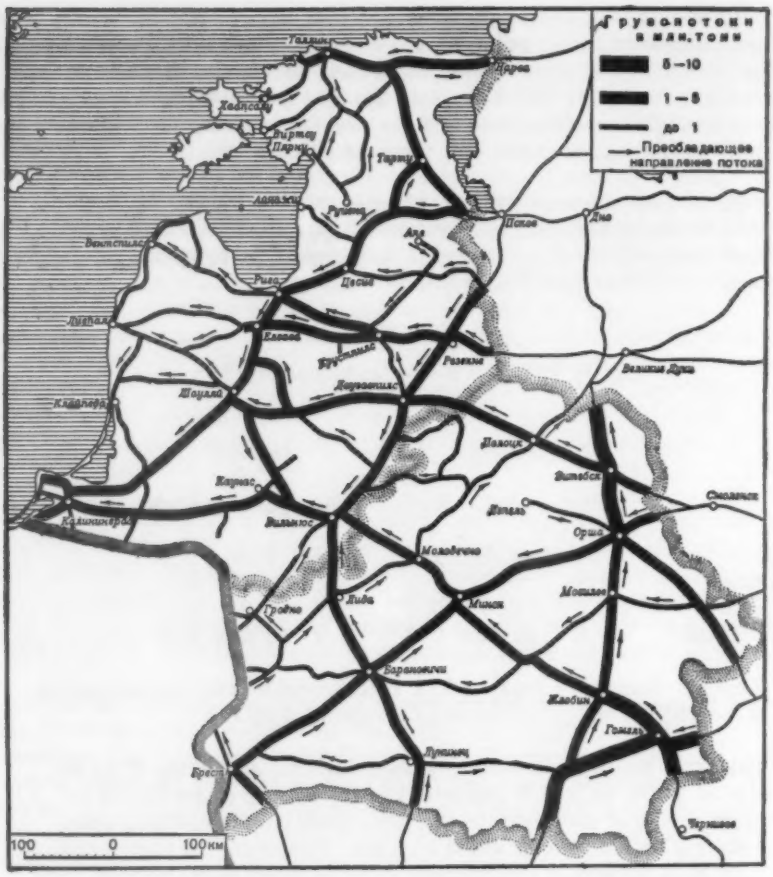


Fig. 47. Freight traffic density on the railroads of the Baltic Region and Belorussia (1955)

(Legend:) Freight flows in million tons
5-10
1-5
less than 1
predominant direction of flow

moves along the line Kaisiadorys-Kaunas-Chernyakhovsk-Kaliningrad, and the lesser part to Daugavpils-Pskov. At Kaisiadorys part of the transit flow out of Vilna moves toward Siauliai, and from there to Riga, Klaipeda and Liepaja (Fig. 47).

Important railroad lines also focus on Riga, with the heaviest traffic on Riga's approaches coming from Krustpils. In the northern part of the Baltic region the principal railroads lead to Tallinn, the capital of Estonia and its largest industrial center and port. The heaviest traffic toward Tallinn moves from Leningrad through Narva-Tapa. This line passes within 10 to 40 km. of the coast of the Gulf of Finland and serves the main industrial towns of Estonia. On the Rakvere-Johvi section the line passes through the oil-shale district. The predominant direction of flow is toward Tallinn. At Tapa there is a merger of traffic from Leningrad through Narva, from Moscow through Pskov-Tartu, and from Riga through Valga-Tartu. The Tapa-Tallinn line has the heaviest traffic in Estonia.

Belorussia (p. 291). The geographical location of Belorussia astride the routes from central European Russia to Western Europe and from the south and southwest to the Baltic region has promoted the creation of a large network of land routes. Belorussia lacks deposits of coal, oil and ores, but has considerable deposits of peat and building materials, as well as forestry and agricultural resources. The lack of cheap fuel and energy resources is a bar to the development of energy-and heat-oriented industries. However a high population density and a dense network of land and water routes has promoted the development of industry in Belorussia, both on the base of imported raw materials and fuels and on the base of local resources. The growth of the machine-building and metal-fabricating industries has received a particular stimulus since World War II; these industries accounted for one-fourth of the gross industrial output and one-fourth of the industrial labor force in 1955. Other important industries are food processing, light industries, lumbering and wood processing. The manufacturing centers are situated mainly in cities situated at transportation junctions. The importance of manufacturing is also reflected in the passive traffic balance. In 1955 incoming freight on railroads amounted to 27.8 million tons and outgoing freight 18.5 million tons; on waterways 2.6 million tons arrived and 1.5 million tons departed (Narodnoye khozyaystvo Belorusskoy SSR (The Economy of the Belorussian SSR), statistical handbook, Minsk, 1957).

Among freight arrivals on railroads in 1955, mineral building materials accounted for 22 per cent, coal and coke 11.9 per cent, grain products 10.7 per cent, oil products 6.2 per cent, iron and steel 5.8 per cent. Rail loadings were broken down as follows: building materials 28.7 per cent, lumber 12.9 per cent, coal and coke 10.7 per cent. Peat plays a substantial role in intra-regional rail traffic (2.6 million tons loaded in 1955).

The average freight-traffic density in Belorussia is below the Soviet average. Small freight flows are formed on lines going in a southwesterly

direction. Belorussia does not have a single especially large transportation hub. Freight flows are formed in several centers that differ little in the volume of freight operations.

Of all the oblasts of Belorussia only two-- Molodechno and Grodno -- have an active railroad traffic balance, largely because of heavy outgoing shipments of building materials.

The heaviest freight traffic density on Belorussia's railroads is found on the lines Smolensk-Orsha-Minsk-Baranovichi-Brest, Bryansk-Gomel'-Kalinovichi-Korosten', Bakhmach-Gomel'-Osipovichi-Minsk-Molodechno-Vilna, Kalinovichi-Zhlobin-Mogilev, and Orsha-Vitebsk-Nevel'. These lines carry a great deal of transit traffic and assure the main connections between Belorussia and other republics. These lines also link the principal manufacturing centers. Railroad stations with the heaviest volume of incoming traffic are: Novobelitsa, Gomel', Mogilev, Vitebsk, Baranovichi, Minsk, Orsha, and Bobruysk; stations with the heaviest outgoing traffic are: Brest, Novobelitsa, Gomel', Vitebsk, Orsha, Minsk, and Mogilev, in that order. The largest amount of transit traffic, exceeding 10 million tons a year, is handled at the stations of Orsha, Novobelitsa, Zhlobin, Vitebsk and Minsk. The stations of Kalinkovichi and Baranovichi also handle a heavy transit traffic. The line Bakhmach-Gomel'-Zhlobin-Osipovichi-Minsk carries a heavy flow of Donbas coal (see Fig. 47).

The South (p. 298). The South includes the Ukraine and Moldavia. The South has a diversified economy with substantial differences in regional specialization. The principal industries are iron and steel, machine building, chemicals and coal mining. The food-processing industry, especially sugar, and agricultural production are also of national importance. The huge economic reserves of the South are important for the entrie Soviet Union. The first coal and steel base of the country, the South produced in 1955 almost half of the Soviet pig iron, 37 per cent of the crude steel and rolled products, almost 60 per cent of the iron ore, and 32 per cent of the coal. The South also accounts for two-thirds of the sugar-beet sowings, one-third of the orchard acreage, more than one-fifth of the cattle and about one-third of the hogs of the Soviet Union. The South has surplus production in several segments of its economy and maintains active links both with other regions of the Soviet Union and with other countries. In view of the geographical location of the South in the southwestern part of the Soviet Union, on the Sea of Azov and the Black Sea, on the Danube Delta, and on the frontiers of Poland, Czechoslovakia, Hungary and Rumania, the region handles both inter-regional and foreign transit traffic.

The development of heavy industry in the South has promoted the growth of railroad transportation, which handles 80 per cent of all traffic. The length of the railroads in the South in 1956 was 21,600 km., or 18 per cent of the national net.

The rail net is densest in the Donets Basin. In view of the character of

the regional economy, the principal freight commodities are coal, ores, building materials, iron and steel, oil, grain and forest products. The South has an active traffic balance in view of the heavy volume of loadings of coal, iron and steel, ores, sugar beets and grain, both for consumption within the region and for shipments to other regions. In 1956 outgoing rail traffic amounted to 381.2 million tons and incoming traffic 346.7 million tons.

About 39 per cent of all rail loadings consist of coal and coke, 11.6 per cent of iron and manganese ores, 11.1 per cent of iron and steel (including scrap, rails and other rolled products), 3.4 per cent of grain and 2.2 per cent of oil products.

The heaviest coal flows originate on the railroads of the Donets Basin. Dnepropetrovsk Oblast accounts for most of the iron-ore loadings. The principal stations loading Krivoy Rog iron ore are: Mudrenaya, Vechernyy Kut, Kalachevskaya, Karnavatka, Rokovataya, Ingulets and others. Nikopol' manganese ore is loaded mainly at the stations of Marganets and Chertomlyk.

Sugar beets and refined sugar make up a large part of the railroad loadings in the oblasts of Vinnitsa, Khmel'nitskiy, Cherkassy, Kiev, Sumy, Poltava, Kirovograd and Khar'kov. In Moldavia sugar beets are the second largest item in railroad loadings with more than 20 per cent of the total volume, after building materials (29.2 per cent). Grain is also an important item in Moldavia, with 10.9 per cent (Narodnoye khozyaystvo Moldavskoy SSR (The Economy of the Moldavian SSR), statistical handbook, Kishinev, 1957).

The heaviest freight-traffic density in the South exists on the line Krinichnaya-Yasinovataya-Krasnoarmeysk-Chaplino-Sinel'nikovo-Nizhnedneprovsk-Verkhovtsevo, where the traffic density on individual sections exceeds 50 million tons per km. in both directions. The freight consists mainly of coal (Fig. 50).

At Krinichnaya station coal flows converge from three directions -- from Khatsepetovka, Ilovayskaya and Puteprovod -- and then continue toward Yasinovataya. A second large freight flow, consisting predominantly also of coal, moves from Debal'tsevo through Khatsepetovka to Nikitovka, Krasnyy Liman, Svyatogorskaya and Khar'kov. From the South to the Center, the heaviest freight flows follow the lines Khar'kov-Belgorod-Moscow and Valuyki-Yelets-Moscow. At Valuyki coal flows converge from two directions -- Kupyansk and Kondrashevskaya. Heavy flows of ore are formed on the line Zaporozh'ye-Apostolovo-Dolgintsevo-Pyatikhatki. From Pyatikhatki the heavier part of the ore flow moves to Dnepropetrovsk and the Donets Basin, and the lesser part to Fastov, Kazatin, Shepetovka, L'vov (for export). Heavy freight flows with a large share of coal also move along the line Yasinovataya-Stalino-Dolya-Volnovakha to Zhdanov.

The industrial structure of the South is also reflected in waterway transportation. The principal commodities in the seaports are oil, ores, coal,

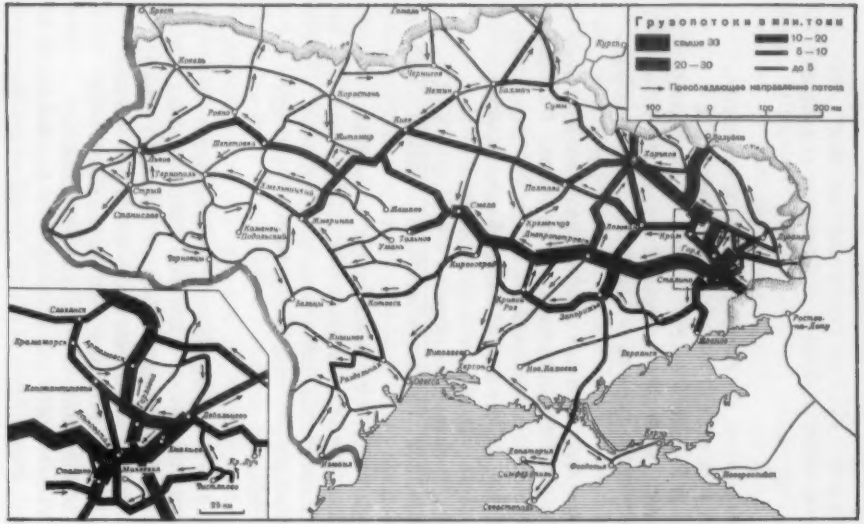


Fig. 50. Freight traffic density on the railroads of the South (1955)
(Legend:) Freight flows in million tons
more than 30 10-20
20-30 5-10
less than 5
predominant direction of flow

iron and steel, grain and sugar. The largest port, Odessa, handles mainly oil products, which it receives from the Caucasus across the Black Sea. Oil products also predominate in the seaports of Kherson and Feodosiya. Ore cargos play a dominant role at Zhdanov, Nikolayev, Reni and Izmail. Coal is handled chiefly by the ports of Odessa, Nikolayev and Zhdanov.

Dnieper River traffic in 1955 included 9.2 million tons of goods, including 2.7 million tons of coal, 1.1 million tons of ores, 2.9 million tons of building materials, 0.47 million tons of oil products and 0.56 million tons of grain (Narodne gospodarstvo Ukrainskoi SSR (The Economy of the Ukrainian SSR), statistical handbook, in Ukrainian, Kiev, 1957, p. 378). Dnieper River transfer points of combined rail-water traffic are at Kherson, Zaporozh'ye, Nizhnedneprovsk, Kremenchug, Cherkassy and Kiev. The heaviest traffic density on the Dnieper River is between Nizhnedneprovsk and Kiev, mainly because of a heavy flow of coal (more than 2 million tons) that is transshipped from railroad to river at Nizhnedneprovsk and moves upstream to Kiev, and in part as far as the Pripet River. A coal-transshipping center of lesser importance is the Port Imeni Lenina (Port named for Lenin) at Zaporozh'ye, from where the coal moves downstream to Kherson. Most of the ore flows that move upstream along the Dnieper also start at the Port Imeni Lenina. Oil products move upstream along the Dnieper from Kherson. The Dnieper ports with the heaviest freight volume are Kiev, Nizhnedneprovsk, Port Imeni Lenina (Zaporozh'ye), Kherson and Novaya Kahkovka.

The Caucasus (p. 308). The Caucasus is understood here to include the economic region of the RSFSR known as the Lower Don and Northern Caucasus and the Transcaucasian republics of Georgia, Azerbaydzhan and Armenia.

The geographical location of the Caucasus has long been an important factor in the region's internal and external relations. The Caucasus Mountains have affected the formation of the pattern of land routes. Two railroads linking Transcaucasia with the Center and the South describe a great ring around the mountains. Major lines and minor spurs branch off from the two main railroads. Railroads link the interior of the Caucasus with ports on the Black Sea, the Sea of Azov and the Caspian Sea. The railroad net is also connected with important waterways -- the Don, the Volga-Don Canal and the Volga. The Caucasus is connected with the rail net of the Soviet Union through three main outlets: Rostov, Stalingrad and Astrakhan'. In addition there is a connection across the Kerch' Strait to Kerch'.

Rostov is the main gate of the Caucasus. Goods are transshipped from railroad to river and vice versa. From Rostov freight moves by water to the upper Don, the Volga-Don Canal and the Volga, along the lower Don to the Sea of Azov, and to the Manych.

Despite substantial differences between the physical and economic conditions of individual parts of the Caucasus, the region as a whole has many transportation features in common and can be regarded as a major transportation region.

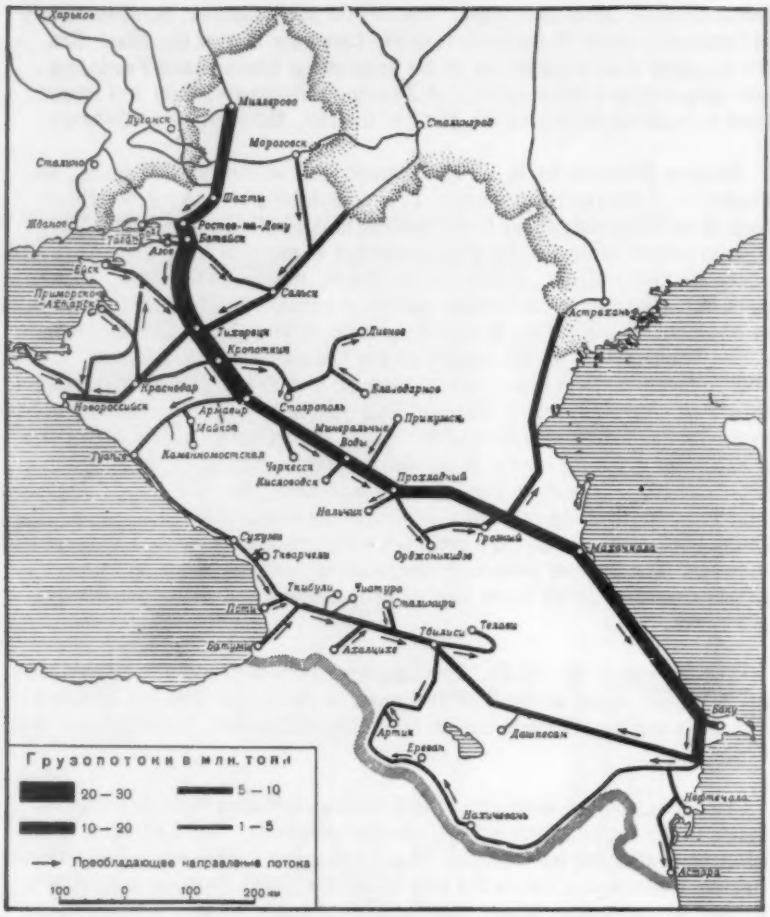


Fig. 53. Freight traffic density on the railroads of the Caucasus (1955)

(Legend:) Freight flows in million tons
20-30 5-10
10-20 1-5
predominant direction of flow

Oil products constitute the principal freight item on railroads and in coastwise shipping, but there are differences in freight structure between the Northern Caucasus and Transcaucasia. The leading commodity in the Northern Caucasus is coal, accounting for 31.2 per cent of all rail loadings in 1955, largely because of the inclusion of the eastern wing of the Donets Basin in Rostov Oblast. In second place in the Northern Caucasus are oil products, and in third grain. In Transcaucasia oil products lead in railroad loadings, followed by manganese ore and coal. In terms of freight traffic (in ton-kilometers) oil products lead both in the Northern Caucasus and in Transcaucasia.

In 1955 the railroads of the Caucasus loaded 99.7 million tons of freight and received 86.6 million tons. The active traffic balance is explained by the heavy loadings of coal in Rostov Oblast and oil in Azerbaydzhan and Dagestan. The other krays and republics of the Caucasus have a negative balance.

A heavy flow of freight traffic moves from Rostov to Baladzhary (Baku), with the predominant direction away from Rostov. The heaviest traffic density is found on the Rostov-Armavir section. Coal, lumber and other goods move toward Armavir. In the opposite direction there is a flow of oil products originating mainly in the Makhachkala area and growing in volume as it passes Groznyy. Part of the crude oil coming from Makhachkala leaves the main line at Gudermes for refining at Groznyy, but most of the crude oil together with some crude from Groznyy moves to the junction of Chervlennaya Uzlovaya, from where the greater part goes on to Armavir and the smaller part branches off to Astrakhan'. Freight traffic density in the direction from Armavir toward Baku is less important, but nevertheless exceeds that of the other railroads of the Caucasus (Fig. 53).

On the southern arm of the great railroad ring around the Caucasus, freight traffic is less important than in the north, and the predominant direction of flow varies with the railroad division. The heaviest traffic occurs on the section Baladzhary (Baku)-Navtlugi (Tbilisi), with the Tbilisi-bound flow predominating. The principal commodity is Baku oil moving to Batumi, part being diverted toward Armenia to supply oil-storage depots along the railroad. On the Navtlugi-Shorapani direction the predominant direction of flow is toward Tbilisi; the flow in that direction consists mainly of coal, with oil products moving in the opposite direction. On the Shorapani-Tskhakaya division there is a predominant westward freight flow consisting mainly of manganese ore moving toward the port of Poti. The Armavir-Tskhakaya section has a lesser traffic density, with the main movement in the direction of Tskhakaya. The traffic density is again greater on the Armavir-Tuapse section, increasing in the direction of Armavir.

Freight flows along the lower Don River are predominantly downstream from the mouth of the Northern Donets. Between the mouth of the Donets and the Volga-Don Canal the traffic is mainly upstream. The section between the mouth of the Donets and Rostov has the greatest traffic density. The main

commodities moving upstream are coal, building materials and grain, and downstream lumber and oil products. Rostov is the principal river port, receiving twice as much freight by river as it sends out.

Coal and building materials are shipped along the Northern Donets to the Don River. The greater part of the coal is loaded at Krasnodon, the principal coal terminal on the Donets. Grain is the principal freight coming from the Manych, with building materials, oil, lumber and coal moving in the opposite direction.

The Volga Region (p. 317). The Volga Region includes the Volga valley from Kazan' to Astrakhan', in which the Volga River route plays the principal role. The Volga is also important for the regional economy, particularly its industrialization, by furnishing hydroelectric power and water for industry, domestic use and agriculture. The region has imported reserves of petroleum, natural gas and oil shale, salt and building materials, as well as large agricultural resources and fisheries. Industrial centers have been established in the Volga Region on the basis of local and important fuels and raw materials thanks to the favorable transport location of the region. Large manufacturing centers have arisen on the Volga at the crossings of major railroad lines.

Even before World War II machine building assumed the dominant place in the regional economy. In the post-war years the oil industry developed and the Volga's hydroelectric resources were utilized. Since the opening of the Kuybyshev and Stalingrad power stations the Volga Region has become a major producer of water power both for local needs and for transmission to other regions. The chemical industry has also become important.

The importance of the Volga River route increased with construction of the Moscow Canal and the Volga-Don Canal, and will rise even further once the reconstruction of the Volga-Baltic waterway is completed. These canals insure inter-regional connections by water between the Volga and other areas and transform the Volga into the key element of the system of internal waterways of European Russia. The series of power-generating dams along the Volga have greatly improved shipping conditions by transforming the river into a deep-water route.

Within the limits of the Volga Region the Volga is crossed by railroads at Kazan', Ul'yanovsk, Syzran', Kuybyshev, Saratov, Astrakhan', and, since the construction of the Stalingrad Dam, at Stalingrad. Railroads also parallel the river -- on the left bank from Astrakhan' through Urbakh to Saratov, and on the right bank from Zelenyy Dol to Stalingrad. The Stalingrad-Baskunchak line offers a shorter outlet by railroad for Baskunchak salt to the Center. After construction of the line Astrakhan'-Gur'yev and the line Kungrad-Makat-Aleksandrov-Gay, the Volga Region will be linked by a shorter rail route with Central Asia.

The Volga-Don Canal has improved connections between the Volga Region

and the Donets Basin. The development of oil and gas has led to the construction of a network of pipelines that is steadily growing.

The principal commodities in Volga River traffic are oil, lumber, grain, building materials, coal and salt. Lumber is the principal commodity moving by river, and oil by railroad (accounting for 40 per cent of all rail loadings in 1955). Oil products are often carried by railroad parallel to the Volga, which is an irrational practice during the shipping season. In the future oil should be increasingly transferred to river traffic.

Railroad loadings exceed river loadings despite the importance of the Volga River. In 1955 railroads in the Volga Region loaded 57.2 million tons of goods and received 57.7 million tons, while 24.1 million tons of freight was shipped and 26.7 million tons received at river terminals. The freight flow along the Volga River is the heaviest of all the southbound flows in the Volga Region. The excess of railroad over river loadings is explained mainly by the large amount of oil loadings originating in the oil fields of Tataria at some distance from the Volga River. Among the railroad loadings, oil accounts for 38.6 per cent (1955), grain 8.7 and lumber 6.3 per cent; iron and steel are also of some importance. It is hoped that rational traffic planning in the future will shift some of the north-south railroad traffic to the Volga River route or combined rail-river routes. Construction of the Ust'-Donetskiy coal transfer terminal (on the Don at the mouth of the Donets) will spur coal traffic along the Volga-Don Canal and the Volga River. A heavy flow of railroad transit moves parallel to the Volga along the line Ruzayevka-Penza-Rtishchevo-Povorino.

The heaviest railroad traffic crosses the Volga at Syzran', Kazan' and Saratov, with the densest traffic through Syzran' consisting mainly of transit freight (Fig. 54). This flow is made up of two lines merging at Kinel': a larger flow from Chelyabinsk in the southern Urals and a lesser flow from the direction of Orenburg. The densest freight traffic in the Volga Region is found along the line Kinel'-Batraki-Syzran'. The Syzran' rail hub handles mainly transit freight, which it receives from and distributes in all directions. The main westbound flow is through Penza. Almost a fourth of all the transit freight consists of oil products. Other freight reaching Syzran' from the east consists of coal, iron and steel, building materials, lumber and grain. Goods moving by combined rail-river routes are transshipped at Batraki and at Kuybyshev.

A second high-density freight route crosses Tataria from Sverdlovsk through Agryz and Kazan' in the direction of Kanash with a predominant westbound flow. The principal westbound commodities are lumber, coal, iron and steel, ores and grain. Another rail-river transfer terminal is at Kazan'.

A heavy transit flow also moves through Saratov, with a predominant westbound flow along the line Urbakh-Saratov-Rtishchevo. Oil products play an even more important role at Saratov than at Syzran', accounting for almost a third of all the freight operations of the Saratov rail hub. Most of the oil freight arrives from the direction of Syzran' and moves through Saratov toward Rtishchevo.

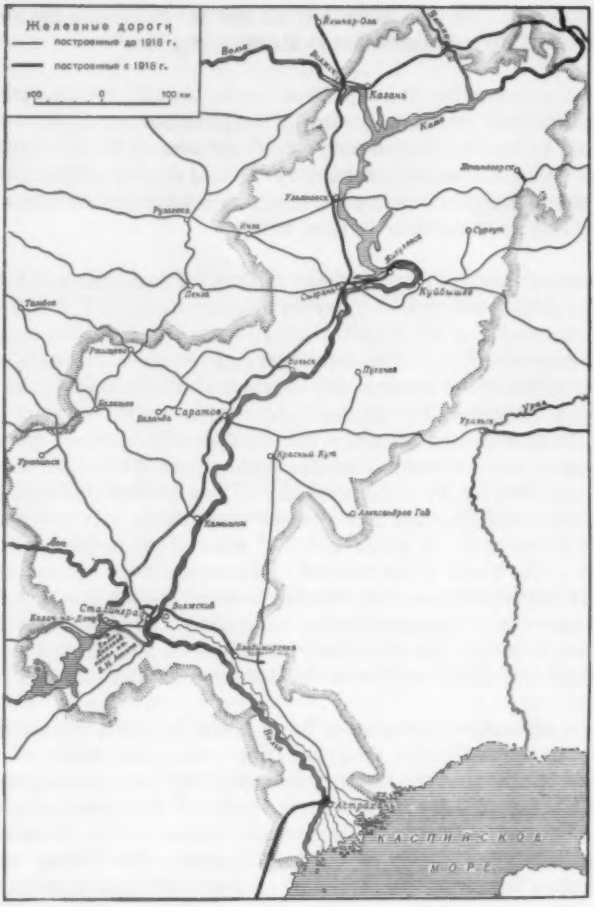


Fig. 54. Railroads of the Volga Region
(Freight-flow map not available)

(Legend:) Railroads built before 1918
Railroads built after 1918

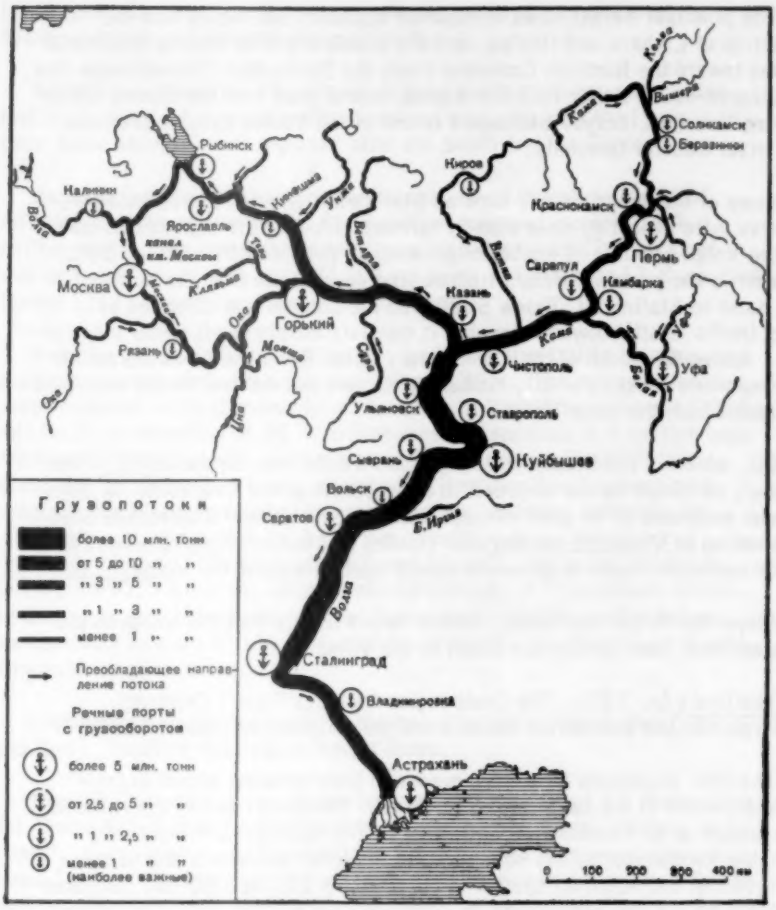


Fig. 30. Freight traffic density on the rivers of the Volga Basin (1955)

(Legend:) Freight flows
more than 10 million tons
5-10 " "
3-5 " "
1-3 " "
less than 1 " "
predominant direction of flow

River ports with their freight turnover
more than 5 million tons
2.5 to 5 " "
1 to 2.5 " "
less than 1 " "
(minor ports not shown)

The principal freight flows by railroad approach Stalingrad from the direction of Likhaya and Ilovlya, and the heaviest traffic leaving Stalingrad moves toward the Northern Caucasus along the Stalingrad-Tikhoretskaya line. Stalingrad-bound traffic includes a great deal of coal from the Donets Basin moving through Likhaya. Stalingrad is one of the Soviet Union's principal rail-river transfer terminals.

Some of the Volga cities, such as Stalingrad, Saratov and Astrakhan', receive more freight by river than by railroad. Most of the downstream traffic on the Volga consists of lumber originating on the Kama River (Fig. 30). Lumber is the principal freight item moving downstream from the mouth of the Kama to Stalingrad. Below Stalingrad the predominant direction of river traffic is still downstream, but it consists mainly of oil rather than lumber. Above the mouth of the Kama River, Volga River traffic moves mainly upstream and consists of oil, lumber, grain and salt moving for the most part in transit from the lower Volga.

Oil, which is the second most important freight item on the Volga, after lumber, no longer moves upstream in all sections of the river route. A downstream movement of oil predominates between Saratov and Stalingrad. Salt originating at Vladimirovka and coal (loaded at Stalingrad) move almost entirely upstream. Grain also moves mainly upstream along the Volga.

Along the Volga-Don Canal, lumber moves mainly from the Volga to the Don and coal from the Donets Basin to the Volga.

The Urals (p. 325). The Urals region includes Perm', Orenburg, Chelyabinsk and Sverdlovsk oblasts and the Bashkir and Udmurt ASSRs.

The Ural Mountains have been eroded to their greatest extent in their middle portion at the latitude of Sverdlovsk. The pass used by the railroad is situated at an elevation of 410 meters. The southern Urals are less suitable for transportation, both because of higher elevations and because the width of the mountain system in the south is 120 to 180 km. compared with 50 km. in the middle section.

The Urals possess a diversified combination of mineral resources, fuels and energy, and forests. The resultant industrial structure is important mainly for its production of iron and steel, nonferrous metals, machinery, chemicals and lumber. Typical of the regional economy of the Urals is the existence in each major industry of several very large plants in addition to smaller enterprises. In the iron and steel industry, for example, there are four giant installations at Magnitogorsk, Nizhniy Tagil (the Novo-Tagil plant), Chelyabinsk and Novotroitsk, which account for nine-tenths of all the iron and steel of the Urals. In machine building there are three very large plants -- the Urals Heavy Machine-Building Plant at Sverdlovsk, the Urals Car-Building Plant at Nizhniy Tagil and the Chelyabinsk Tractor Plant. Large chemical installations are the chemical plant at Berezniki, the potash plant at Solikamsk and the superphosphate plant at Perm'. In the

forest-products industry, the paper-and-pulp mills of Krasnokamsk, Krasnovishersk and Borovsk are outstanding.

Railroads account for 85 per cent of the combined railroad and water traffic. In terms of railroad traffic (loadings plus receipts) the Urals is in third place among Soviet regions, after the South and the Center.

Railroad loadings and receipts are almost equal in volume (in 1955 railroad loadings amounted to 185.2 million tons and receipts 184.4 million tons). The principal commodities loaded are coal (26 per cent), iron and steel, including scrap (10.7 per cent), oil products (7.8 per cent), lumber (7.7 per cent) and ores (7.0 per cent).

Actually the Urals have traditionally had a passive traffic balance, and loadings have exceeded receipts only since 1955. The active balance arose because of the increase in oil loadings in Bashkiria, where in 1955 rail loadings amounted to 15.0 million tons and receipts 9.6 million tons. Besides Bashkiria, there is an active traffic balance in Perm' Oblast (loadings 29.7 million tons, receipts 23.8 million tons), where coal accounts for 40.1 per cent of the rail loadings, building materials for 16.8 per cent and lumber for 11.2 per cent (Narodnoye khozyaystvo Permskoy oblasti (The Economy of Perm' Oblast), statistical handbook, Perm', 1957). Loadings slightly exceed receipts in Chelyabinsk Oblast. In the future that oblast will have an increasingly passive traffic balance as Kustanay iron ore will be delivered by railroad to the Magnitogorsk and Chelyabinsk steel mills.

Sverdlovsk and Chelyabinsk are the two principal railroad centers of the Urals, handling the largest freight flows.

Through Chelyabinsk passes the heaviest freight flow of the Urals along the Trans-Siberian and westward through Berdyaush, Dema, Chishmy and Kinel'. Large westbound freight flows out of Siberia also move along the lines Tyumen'-Bogdanovich-Sverdlovsk, through Kugan-Sinarskaya-Sverdlovsk and through Akmolinsk-Kartaly-Magnitogorsk. Westward traffic from Siberia and Kazakhstan to the Urals predominates on all four lines. The main westbound commodity is coal, followed by lumber and grain. From Chelyabinsk traffic moves north toward Sinarskaya, south along the line Kartaly-Nikel' (Orsk)- Orenburg-Kinel', west toward Berdyaush and northwest to Sverdlovsk (Fig. 56).

At Sverdlovsk seven lines converge, of which the two western lines, through Kungur-Perm' and through Druzhinino-Agryz-Kazan', have a predominantly westbound traffic flow. On the five other lines Sverdlovsk-bound traffic prevails. A major traffic flow made up at Perm' by the merger of traffic from the direction of Goroblagodatskaya and the direction of Kuzino moves predominantly westward through Kirov. This is the route used by coal, iron and steel, lumber and grain moving from the Urals.

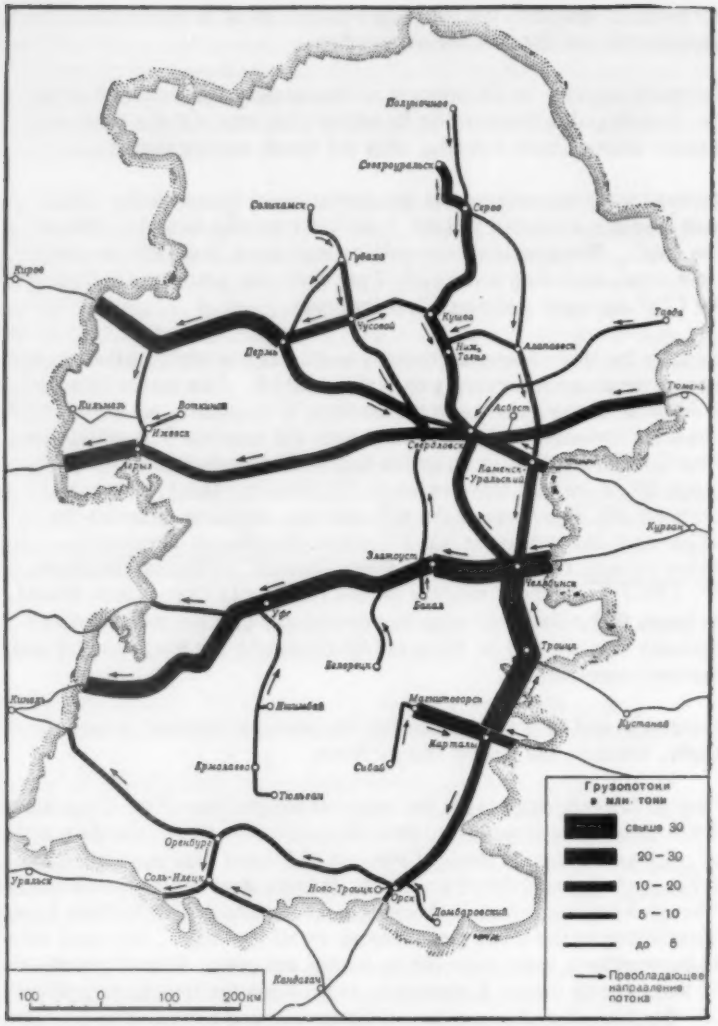


Fig. 56. Freight traffic density on railroads of the Urals (1955)

(Legend:) Freight flows in million tons

more than 30
20-30
10-20
5-10
less than 5

predominant direction of flow

Coal is an important part of all freight flows in the Urals. Ores and iron and steel are carried mainly on the railroads of Sverdlovsk and Chelyabinsk oblasts. A great deal of ore figures among railroad receipts in Orenburg Oblast -- 16 per cent of all incoming freight (Narodnoye khozyaystvo Orenburgskoy oblasti (The Economy of Orenburg Oblast), statistical handbook, Orenburg, 1957). The heaviest iron and steel traffic moves on the line Magnitogorsk-Kartaly. Heavy shipments of oil products move out of Bashkiria along the line Dema-Berdyaush-Chelyabinsk and eastward.

Siberia (p. 335). The bulk of the freight traffic in Siberia takes place along the Trans-Siberian Railroad, and in general the principal transport lines of Siberia are oriented latitudinally. This corresponds to the present location of the region's productive forces. Most of the industrial centers are located within the zone of the Trans-Siberian or on short spur lines. West of Cheremkhovo traffic on the Trans-Siberian is predominantly westbound, increasing steadily in volume in that direction. East of Cheremkhovo the predominant direction of traffic is eastbound. North-south connections are assured by the rivers. Rail-river transfer terminals exist at all the points where the great Siberian rivers cross the Trans-Siberian Railroad: Omsk, Novosibirsk, Krasnoyarsk, Tomsk, Tyumen', Makar'yevo (near Cheremkhovo), Zayarsk, Tankhoy, Ulan-Ude.

The development of resources in areas at some distance from the Trans-Siberian depends on the construction of north-south railroad lines linking up with the Trans-Siberian. The Far North is served by the Northern Sea Route, which is expected to play an increasingly important role with the use of atomic icebreakers.

Western Siberia. Kemerovo Oblast, with its Kuznetsk Basin, is the industrial heart of Western Siberia and accounts for a large part of the region's freight traffic. Coal accounts for 60 per cent of the total rail tonnage shipped and received. Other important commodities are ores, iron and steel, and lumber (mainly as incoming freight). Kemerovo Oblast has a pronounced active traffic balance, with 78.5 million tons of outgoing and 36.2 million tons of incoming freight in 1955. Rail loadings are steadily increasing as coal mining expands. Coal output increased from 22.5 million tons in 1940 to 58.5 million tons in 1955 and 80 million in 1959. More than 40 per cent of the Kuzbas coal is consumed in Kemerovo Oblast and other parts of Western Siberia; about 40 per cent is shipped to the Urals.

The main traffic flows in the Kuznetsk Basin move along the line Tashtagol-Artyshta-Proyektnaya-Ob' (Novosibirsk). Along this line iron ore from Gornaya Shoriya moves to Stalinsk. From Stalinsk the traffic volume increases sharply, consisting mainly of coal and iron and steel. A major freight item in the opposite direction is lumber, moving through Yurga-Topki-Proyektnaya (Fig. 58).

There is also a high traffic density on the Trans-Siberian, consisting mainly of westbound traffic of coal and lumber. Siberian lumber also moves to Kazakhstan and Central Asia through Sokur-Inskaya-Altayskaya.

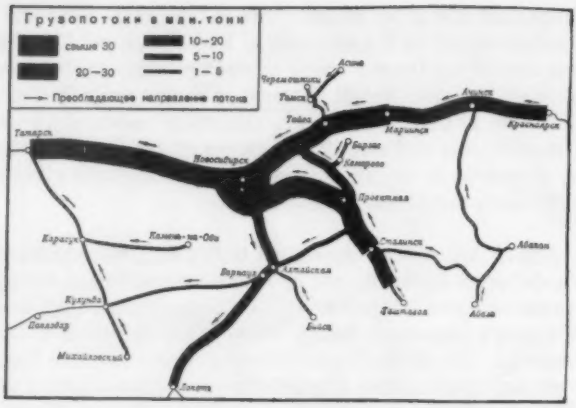


Fig. 58. Freight traffic density on the railroads of the Kuznetsk Basin (1955)

(Legend:) Freight flows in million tons
more than 30 10-20
20-30 5-10
1-5
predominant direction of flow

The growth of the economy of the Kuznetsk Basin has required the construction of new railroad outlets, especially in a western direction. After World War II the South Siberian Railroad was completed from Artyshta through Altayskaya and Akmolinsk to Magnitogorsk. However the main flow of Kuzbas coal moves toward the middle Urals and Chelyabinsk. To ease the traffic load on the Ob' (Novosibirsk)-Omsk section, a new outlet was conceived through Altayskaya-Kamen' on the Ob'-Karasuk-Kokchetav-Kustanay (the Middle Siberian Railroad). Construction of this line is to be completed in the current seven-year plan. Traffic connections between the Kuznetsk Basin in an eastward direction (mainly with Middle Siberia) are also increasing. (Editor's note, S. G. The terminology "Middle Siberia" is confusing. It applies both to the railroad running halfway (in the middle) between the Trans-Siberian and the South Siberian, and to the region in the "middle" of Siberia, between the Kuznetsk Basin and Lake Baykal.) The Stalinsk-Abakan railroad, completed in 1958, will not only make possible the development of new coal, manganese, iron ore and other deposits of the Kuznetskiy Alatau, but provide a shorter eastward outlet from the southern Kuznetsk Basin to Eastern Siberia.

Several large railroad freight-handling stations have arisen at rail junctions in the Kuznetsk Basin: Artyshta, Proyektnaya, Topki, Yurga. The large urban centers of the Kuzbas are situated on the main lines and linked with a network of spurs with their coal mines and industrial plants. Since the

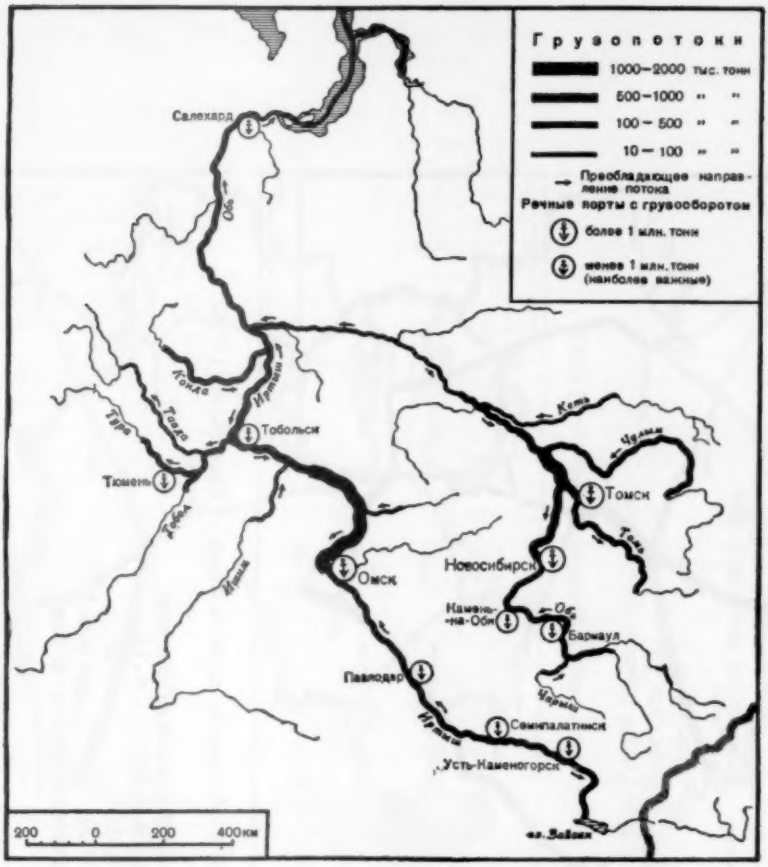


Fig. 60. Freight traffic on the rivers of Western Siberia (1955)

(Legend:) Freight flows

1000-2000 thousand tons
500-1000 " "
100-500 " "
10-100 " "
predominant direction of flow

River ports and their freight turnover

more than 1 million tons
less than 1 million tons
(minor ports not shown)

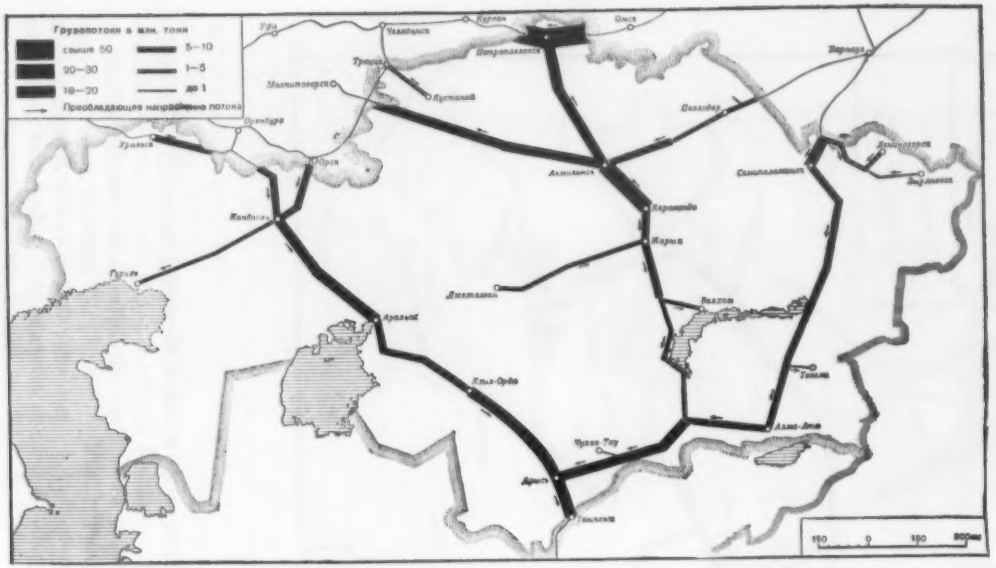


Fig. 68. Freight traffic density on the railroads of Kazakhstan (1955)

(Legend:) Freight flows in million tons

more than 50	5-10
20-30	1-5
10-20	less than 1

predominant direction of flow

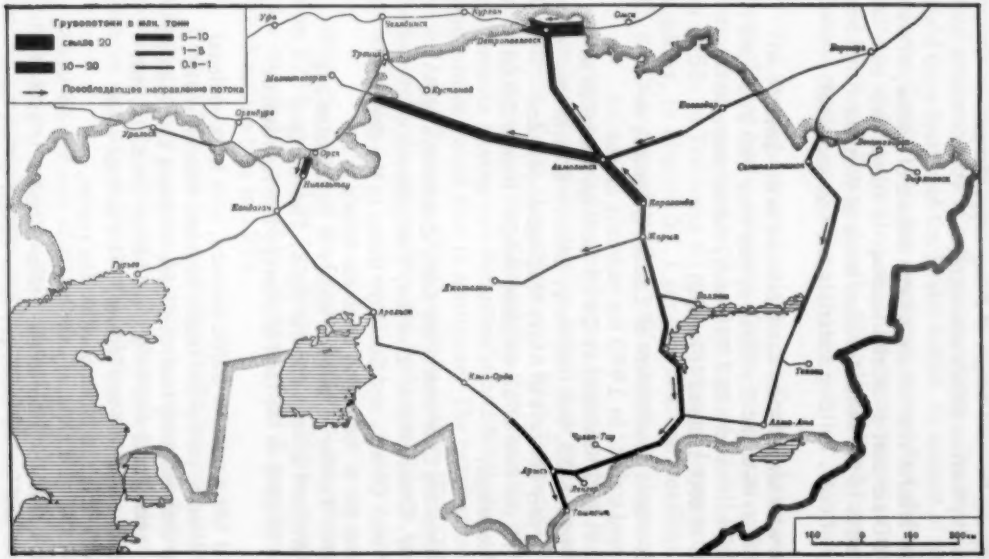


Fig. 67. Coal traffic on the railroads of Kazakhstan (1955)

(Legend:) Freight flows in million tons
more than 20 5-10
10-20 1-5
0.5-1
predominant direction of flow

construction of the eastern section of the South Siberian, Stalinsk has added important transportation functions to its role as a coal, steel and machinery producer.

Except for Kemerovo Oblast, Western Siberia has a passive traffic balance, with grain making up the principal item in rail loadings. It accounts for more than 30 per cent of all outgoing railroad freight in Altay Kray, Kurgan, Novosibirsk and Omsk oblasts, moving mainly westward.

The railroads of Western Siberia also handle a large amount of lumber, which makes up more than 50 per cent of all rail loadings in Tomsk and Tyumen' oblasts. Rail receipts in the wooded-steppe areas of Western Siberia are made up mainly of coal, building materials and iron and steel.

Traffic on the Ob-Irtysh waterway system has increased in the Soviet period as loadings in the Ob' system and the Irtysh system rose from 1.8 million tons in 1932 to 7.2 million tons in 1956 each, the volume of traffic being virtually equal in both systems (Fig. 60).

Eastern Siberia. The economic development of Eastern Siberia is reflected in the region's railroad traffic. In 1940 the railroads loaded 18 million tons and received 15.5 million tons; by 1955 loadings amounted to 49.6 million tons and receipts to 38.9 million tons. Eastern Siberia has an active traffic balance, largely because of heavy loadings of coal and lumber, which account for 70 per cent of all outgoing freight. Irkutsk Oblast leads in the volume of rail loadings.

Large coal-loading stations are Chernogorskiye Kopi, Zaozernaya and Adadym in Krasnoyarsk Kray, Cheremkhovo, Zhargon, Kas'yanovka, Grishevo and Zabituy in Irkutsk Oblast, and Gusinoye Ozero in the Buryat ASSR. Coal shipments going out of the region originate mainly in the Minusinsk and Irkutsk basins. Lumber is shipped mainly to Kazakhstan and Central Asia, followed by Western Siberia and the Urals. Two-thirds of the East Siberian lumber is shipped in the form of pitprops and roundwood.

Far East. The Far East has a passive traffic balance, with intra-regional traffic accounting for a substantial part of the total. Receipts from other regions are three times larger than outgoing traffic. Among incoming commodities are oil products and grain; among outgoing freight are fishery products, nonferrous concentrates, cement, scrap iron and lumber. The Far East also receives a great deal of salt, which is lacking within the region.

The predominant direction of traffic flow on the Trans-Siberian is eastward. Because of heavy coal and lumber loadings, Amur Oblast differs from the rest of the region in having an active traffic balance. Coal accounts for 40 to 45 per cent of all rail loadings in the Far East, followed by building materials (20 per cent), lumber, oil and grain.

Kazakhstan (p. 363). (Editor's note, S. G.: The chapter on

Kazakhstan is substantially identical with the article printed in Soviet Geography, March 1961, pp. 44-54. For completeness, the two traffic flow maps from Nikol'skiy's book are reprinted here on pp. 88-89.)

Central Asia (p. 380). The Soviet republics of Central Asia have a certain economic unity through specialization in cotton growing, stock raising, silk-growing, winegrowing and fruit growing. Mining, light industries and food processing are of national importance. The republics of Central Asia yield three fourths of the Soviet cotton. In support of its specialized industries Central Asia has developed its own fuel and energy base, machine building and chemical industry. Uzbekistan supplies agricultural machinery and fertilizer; Turkmenia oil; Kirgizia coal and sugar; Tadzhikistan nonferrous metals.

The economic specialization of the Central Asian republics is reflected in the freight traffic structure. Cotton freight (raw cotton, ginned cotton, cottonseed) accounted for 16.1 per cent of all rail loadings of Uzbekistan in 1955. In Turkmenia oil products account for more than half of the rail loadings. In Kirgizia 57.1 per cent of all rail loadings were coal in 1955 (1.8 million tons out of 3.2 million tons).

The main railroad line of Central Asia goes from Krasnovodsk to Tashkent and on into Kazakhstan through Arys'. Spur lines branch off at Mary, Chardzhou, Kagan, Ursat'yevskaya, Kzyl-Tukumachi, Tashkent and Salar. West of Kagan eastbound freight flows predominate, consisting mainly of oil products moving from Krasnovodsk and Nebit-Dag. East of Kagan the predominant freight flow is westbound. The heaviest traffic density occurs in the Arys'-Tashkent-Ursat'yevskaya section (Fig. 70), which handles lumber and grain arriving from the Turkestan-Siberia Railroad, and outbound oil and cotton.

While the length of the Central Asian rail net increased by 80 per cent from 2700 km. in 1913 to 5000 km. in 1956, freight traffic (loadings plus receipts) increased by 20 times, from 3.9 million tons in 1913 to 77.4 million tons in 1956.

Central Asia now has a passive traffic balance. In the past only Uzbekistan had a passive balance, but as manufacturing industries were developed in the other republics, incoming shipments of raw materials increased and exceeded outbound freight movements.

About 65 per cent of all railroad receipts originate within one of the Central Asian republics (intra-regional traffic). About 5 to 6 per cent of the incoming freight originates in Kazakhstan, and about 30 per cent in more distant regions of the Soviet Union.

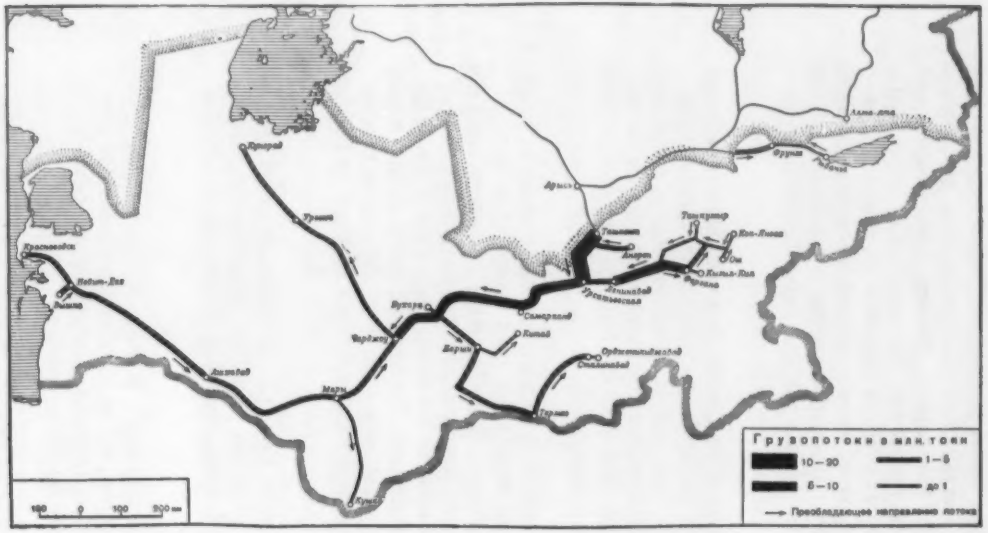


Fig. 70. Freight traffic density on the railroads of Central Asia (1955)

(Legend:) Freight flows in million tons

10-20	1-5
5-10	less than 1

predominant direction of flow

NEWS NOTES

By Theodore Shabad

Nazarovo Power Station Starts. The Nazarovo thermal power plant (Krasnoyarsk Kray) began to generate electricity in April 1961 following installation of its first 150,000-kw. generating unit (Sovetskaya Kirgiziya, April 1, 1961). The start of power generation at the station had originally been scheduled for 1960 (see Soviet Geography, October 1960, p. 79). The Nazarovo station has a designed capacity of 1,200,000 kw. (a first section of four 150,000-kw. units and a second section of three 200,000-kw. units). It is expected to stimulate the development of the Achinsk industrial district on the hairpin bend of the Chulym River. The district includes the alumina plant of Achinsk, the thermal plant at Bogotol, the oil refinery of Kritovo (between Achinsk and Bogotol) and the Itat thermal power plant at the western end of the Chulym bend. These industrial projects are planned for completion under the current seven-year plan (1959-65).

Two New Tatar Oil Cities Under Construction. The city of Nizhnekamsk, with a planned population of 250,000, is under construction on the Kama River to serve a newly developed oil field in the area of Yelabuga-Naberezhnyye Chelny. Nizhnekamsk is expected to become the second largest city of the Tatar ASSR after Kazan'. A second new oil city, to be called Dzhalil' (for Musa Dzhalil', a Tatar poet), is planned for the site of the new Al'keyev oil field, 30 miles northeast of Almet'yevsk (Sovetskaya Rossiya, March 31, 1961).

Baku Offshore Oil Development. A causeway is under construction 25 miles south of Baku to link the islands of Duvannyy and Bulla with the mainland and to facilitate the development of offshore oil wells in the area. The Duvannyy causeway is the third to be built in the Baku area in recent years. The two others link the Apsheron Peninsula, on which Baku stands, with Neftyanyye Kamni (east) and Peschanyy Island (south) (Ekonomicheskaya Gazeta, March 7, 1961).

New Krivoy Rog Concentrator Opens. The Central Concentrator began operations in March 1961. It is one of five concentrators in the Krivoy Rog iron-ore basin that will convert iron quartzites with a metal content of 30 to 35 per cent into iron concentrate with a metal content of 60 to 65 per cent. Two other concentrators in operation are the Southern Concentrator (first section completed in 1955, second section 1960; see Soviet Geography, March 1961, p. 82) and the Novo-Krivoy Rog Concentrator (completed in 1959). Two others under construction are the Northern and Ingulets concentrators (Pravda Ukrainy, March 15, 1961).

Sterlitamak Synthetic Rubber Plant Completed. With the opening of a butane dehydrogenation unit, the Sterlitamak synthetic rubber polymerization plant (Bashkir ASSR) was completed in April 1961 (Ekonomicheskaya

Gazeta, April 19, 1961). The plant produces synthetic rubber through the polymerization of butadiene (obtained locally through the dehydrogenation of butane) and methyl sterene (obtained from the synthetic alcohol plant at Ufa; see Soviet Geography, June 1960, p. 76).

Odessa Building New Port. A new port for Odessa is under development at Ilyichevsk, 15 miles south of Odessa, on an inlet of the Black Sea known as Sukhoy Liman (Ekonomicheskaya Gazeta, March 23, 1961). The new port will be used mainly for bulk goods, such as coal, cement and sand.

Gor'kiy-Zavolzh'ye Railroad Electrified. An electric railroad has been completed between Gor'kiy and Zavolzh'ye (Ekonomicheskaya Gazeta, March 28, 1961). Zavolzh'ye is a relatively new town situated upstream from Gor'kiy at the dam of the 400,000-kilowatt Gor'kiy hydroelectric station on the Volga River. Zavol'zhye has an engine plant for the Gor'kiy automobile industry. Opposite Zavolzh'ye, on the left bank of the Volga, is the old town of Gorodets with a boatyard.

Population of Greater Moscow. The population of Greater Moscow within the expanded city limits (see Soviet Geography, December 1960, p. 90) is now given as 7.2 million (Sovetskaya Rossiya, March 1, 1961).

A City Named Khrushchev. The settlement of Khrushchev, situated at the dam of the Kremenchug hydroelectric station (see Soviet Geography, January 1961, pp. 77-78), has been merged with the near-by city of Georgiyevsk to form the city of Khrushchev (Vedomosti Verkhovnogo Soveta, 1961, No. 14).

CURRENT LITERATURE

The National Research Council (Translations Section, The Library), Sussex Drive, Ottawa 2, Canada, publishes a complete translation of the Soviet journal Problemy Severa (Problems of the North). The translations began with No.1, 1958. The first issue was released in December 1960: issues two and three are to be released during 1961, and subsequent issues will be released irregularly as published in the Russian. Subscription prices are $7.00 per issue and $1.00 for single papers.

The following are some of the articles of geographical interest that appear in the first issue:

The role of continental drainage in the current regime of the Arctic. V. S. Antonov
Some considerations on the geological history of the Arctic. V. N. Saks
The Anyuy volcano and problems of quaternary volcanic activity in northeastern U.S.S.R. E. K. Ustiyev
Natural conditions and vegetation in the mammoth epoch in northern Siberia. B. A. Tikhomirov. (Rept. read to the Danish Botanical Soc. of Copenhagen U. in Nov. 1955.)
Some regularities in the distribution of the vegetation in the arctic tundra. V. D. Aleksandrova. (Previous1 reproduced as a translation in Arctic 13 (3): 147-162.)
The wealth and conservation of the animal resources of the Soviet Arctic. S. M. Uspenskiy
Management of the socialist development of the Soviet north: methods and forms. S. V. Slavin
The earliest traces of man on the Olenek River. A. P. Okladnikov and A. P. Puminov

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The following articles of geographical interest appeared during 1960 in Central Asian Review, a quarterly review containing excerpts from and summaries of articles, books, and documents published in the U.S.S.R. and pertaining to its six Muslim republics. (Central Asian Review is issued by the Central Asian Research Centre, 66 King's Road, London, S. W. 3, in association with St. Antony's College (Oxford) Soviet Affairs Study Group. The annual subscription is Thirty Shillings ($4.20)).

Vol. VIII, Nos. 1 and 2, 1960:
Irrigation in Central Asia. Part I and Part II.
Vol. VIII, No. 3, 1960:
The peoples of Southern Turkmenistan and Khorasan in the 17th and 18th Centuries.

The Economy of Afghanistan (1. Water Resources. II. Foreign Trade 1900-45. III. Afghanistan's "Guided Economy").

Vol. VIII, No. 4, 1960

The Turkic nationality and speech in the USSR in 1959: an analysis of the census results.

The following articles of geographical interest appeared in recent issues of Soviet Soil Science, a monthly translation journal (see Soviet Geography, June 1960, p. 80).

No. 2, February, 1959 (translation printed Sept. 1960):

Immediate problems in soil science in Bulgaria. I. T. Stranski

No. 3. March 1959 (translation printed Oct. 1960):

The problem of soil classification in the eastern part of the Great Caucasus (Azerbaydzhan SSR). G. A. Aliyev

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KRATKAYA GEOGRAFICHESKAYA ENTSIKLOPEDIYA (Short Geographical Encyclopedia), Moscow: Sovetskaya Entsiklopediya, 1960. Vol. 1: Aare-Dyat'kovo, 563 pp.

The first volume of this four-volume geographical encyclopedia was published late in 1960 in Moscow. The three other volumes are to be published during 1961-63. The encyclopedia has a total of 16,000 entries arranged in alphabetical order, including 3,500 entries on geographical generic terms and more than 11,000 entries on place names of the Soviet Union (1959 census figures are given for cities) and foreign countries. Volume 4 will contain 400 articles on ethnic groups of the world and 1000 biographical sketches of geographers and travelers as well as a chronological table of important geographical discoveries and travels. The entries are accompanied by 130 color maps, of which half are hypsometric maps and half special-purpose maps (economic, soils, etc.); in addition there are 400 black-and-white maps and 1200 photographs. The editorial board, headed by A. A. Grigor'yev, editor-in-chief, consists of the following geographers: P. M. Alampiyev, D. L. Armand, A. N. Baranov, I. P. Gerasimov, P. I. Glushakov, S. V. Kalesnik, D. M. Lebedev, Ye. N. Lukashova, I. M. Mayergoyz, F. N. Petrov, V. V. Pokshishevskiy, K. M. Popov, G. D. Rikhter, V. P. Tikhomirov (deputy editor-in-chief).